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FRED W. VOGEL, Editor

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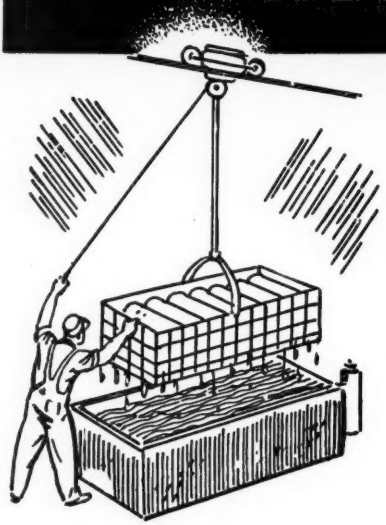

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Wanted --- An Editor

EACH month for the past six and one-half years our editor—Fred W. Vogel—has put together PRODUCTS FINISHING to keep American metal finishing executives informed as to the latest developments in our field. The success of this effort has been evidenced by the growth of the magazine, not only by the increase in circulation but in advertising content as well. During these six and one-half years he has become very well known to many of you both through his work and personal contacts.

Now the time has come, as it has to many of his friends and colleagues, to take a part in that which is at the moment a bigger and more important job—doing his bit in the Armed Forces to insure the continuance of the American Way of Life under a free American Government. Our sincere wishes go with him in his new effort.

In the meantime, PRODUCTS FINISHING must carry on, but we are up against the immediate need of finding an able person to take over Mr. Vogel's task. Somewhere there is undoubtedly an expert in the metal finishing field whose business affiliation has been temporarily affected by the war and who could undoubtedly, with some assistance, handle this task.

Obviously for such a task one must have a fairly good command of English. The editor of this magazine must have a knowledge of processes involved in electroplating, metal polishing, metal cleaning, and the accessory operations. It is also helpful to know the chemistry of paints, varnishes and enamels, and their applications.

We invite letters from those of our readers who feel capable of handling this position.

NOVEMBER, 1942 Vol. 7, No. 2

The Electrodeposition of Hard Nickel

By W. A. WESLEY* AND E. J. ROEHL**

MANY new problems arising in defense activities involve surfacing of parts to resist wear and corrosion, the forming of unusual metal shapes, and the salvaging of worn and mismachined parts. These are creating interest in the electrodeposition of heavy layers of metal for engineering uses; hence it is now an appropriate time to present the results of recent laboratory study and pilot plant-scale operation of plating baths from which hard nickel can be deposited. The goal was to provide the mechanical engineer and the design engineer with a corrosion-resistant electroformed metal of a high degree of hardness and tensile strength coupled with satisfactory ductility, machinability, a temperature coefficient of expansion close to that of steel, good adherence to the basis metal and at a moderate cost. In the plating process a high cathode current efficiency, good throwing power and a high rate of deposition were sought and largely attained.

An early stage in this development was described[1] † in 1938. At that time it was shown that thick deposits of hard nickel could be made from Macnaughtan and Hothersall's double salt bath[2] at rates high enough to be commercially economical, by suitable correlation of plating conditions. There were several features of the process as then practiced which were unsatisfactory and will be discussed later. A more or less systematic study was undertaken to determine the effects of changes in electrolyte composition and to develop a reliable procedure for producing sound, thick, hard deposits with superior physical properties.

*Assistant Director and **Research Chemist, respectively, Research Laboratory, The International Nickel Co., Inc., Bayonne, N. J.

† All footnotes refer to references at the end of the article.

Experimental

The experimental deposits were prepared in glass battery jars containing 10 L. of electrolyte and of dimensions 7¼ in. wide by 9¼ in. long and 12 in. deep (18 x 23 x 30 cm.). A constant-temperature water bath was employed to maintain the desired electrolyte temperature ± 1.0 deg. F. (± 0.5 deg. C.). Two flat nickel anodes were used in each jar, the immersed area of each being 8 in. wide by 8 in. deep (20 x 20 cm.). The cathode was midway between them, so that the anode-to-cathode spacing was 3 in. (7.5 cm.). Anodes were covered with bags which were in some instances of glass fiber filter cloth, otherwise of heavy canvas cloth. Cathodes were of mild steel, either flat (3 x 6 x 0.032 in.). (7.5 x 15 x 0.08 cm.) or cylindrical (5 in. long by 0.5, 1.0 or 2 in. in diameter) (12.7 by 1.27, 2.5 or 5 cm.).

Stratification in the electrolyte was prevented by introducing a slow stream of air bubbles through a porous alundum thimble at a bottom corner of the jar. When additional agitation was desired, a cylindrical cathode was used which was rotated on its own axis at 100 r.p.m. The compositions of the solutions used are summarized in Table I. They were prepared from technical salts and were purified by addition of an excess of freshly prepared nickel peroxide which is an active oxidizing agent. Besides its oxidizing effect upon at least some organic contaminants, it causes precipitation of iron, copper and zinc. The solutions were filtered as often as required to avoid rough electrodeposits. A commercial glass electrode apparatus was used to measure pH and this was checked periodically against standard buffer solutions.

Hardness measurements were made with the Vickers apparatus, using a diamond pyramid point and a 10 kg. load. The minimum deposit thickness tested was 0.006 in. (0.15 mm.). Deposits more than 0.04 in. (1 mm.) thick were lightly polished with fine emery to present a surface smooth enough for accurate hardness readings.

Characteristics of Original Bath.

When the Macnaughtan and Hothersall electrolyte[2] was being employed here in practical plating at the relatively high cathode current density of 50 amp./sq. ft. (5.4 amp./dm.^{2}), it was observed that the anode efficiency dropped whenever cathodes of an area approaching the anode area were being plated, that is, whenever the anode current density was increased above perhaps 30 amp./sq. ft. (3.2 amp./dm.^{2}). This difficulty was avoided by increasing the chloride content of the bath to give a composition called "Original Bath" in Table I. A rather large amount of practical hard nickel plating was performed with baths of this composition. Table II presents some results of miscellaneous laboratory tests which show conditions employed to obtain deposits of over 400 Vickers hardness. Only feeble evidence of systematic variation

TABLE I

Composition of Electrolytes

Grams per Liter

Bath No.	Nickel Sulfate $NiSO_4 \cdot 7H_2O$	Ammonium Sulfate $(NH_4)_2SO_4$	Ammonium Chloride NH_4Cl	Potassium Chloride KCl	Boric Acid H_3BO_3	Nickel Chloride $NiCl_2 \cdot 6H_2O$	Designation
Y	120	21		8			Macnaughtan and Hothersall
1	120	21	6	8			Original Bath
2			17	8		205	Chloride Bath
3	90	16	4.5	6		30	
4	90	16	4.5	6	30	30	
5	180		25		30		Modified Bath

TABLE II

Hardness of Deposits from Original Bath

Bath No. 1. Cathode current density: 50 amp./sq. ft. (5.4 amp./dm.²). Cathode: Steel rod 1.3 cm. (0.5 in.) in diameter, immersed length 10 cm. (4 in.).

Temperature		pH (Electro.)	Cathode Rotation	Deposit Thickness		Hardness Average
120° F.	49° C.	5.5	0 r.p.m.	0.006 in.	0.15 mm.	467 Vickers
		5.6	100	0.016	0.40	418
130	54	5.4	0	0.007	0.18	475
		5.4	100	0.010	0.25	455
		5.6	0	0.010	0.25	440
		5.6	100	0.080	2.0	465
		5.8	100	0.045	1.13	470
		6.0	0	0.008	0.20	480
140	60	5.5	0	0.008	0.20	480
		4.8	100	0.008	0.20	456

of hardness with either pH or temperature can be found in these data.

Although many satisfactory deposits were being produced, there were several features of the process which were unsatisfactory, and the number of rejects due to these difficulties was considered too high:

(1) Deposits thicker than 0.02 in. (0.5 mm.) had a laminated structure and in many cases the layers separated when they were subjected to mechanical abuse or machining.

(2) The hardness of the deposits could not be closely controlled. This difficulty was complicated by the fact that the hardness of the outer surface varied with increasing thickness of the deposit and also that the hardness was markedly influenced by the nature of the basis metal.

(3) There was a pronounced tendency for growth of "trees" at the corners of the cathode.

(4) The bath was poorly buffered, hence frequent attention was required

TABLE III

Hardness of Deposits from Chloride Bath

Bath No. 2 of Table I. Cathode current density: 50 amp./sq. ft. (5.4 amp./dm.²). Cathode: Stationary steel rod 0.5 in. (1.3 cm.) in diameter.

Temperature		pH	Thickness		Average Hardness
110° F.	43° C.	5.6 Electro.	0.050 in.	1.25 mm.	370 Vickers
		5.8	0.015	0.38	409
		6.0	0.031	0.76	440
120	49	5.6	0.025	0.63	350
		5.8	0.015	0.38	385
		6.0	0.014	0.36	430
130	54	5.7	0.014	0.36	350
		5.9	0.015	0.38	382
		6.0	0.010	0.25	398
140	60	5.9	0.020	0.50	361
		6.0	0.018	0.45	377

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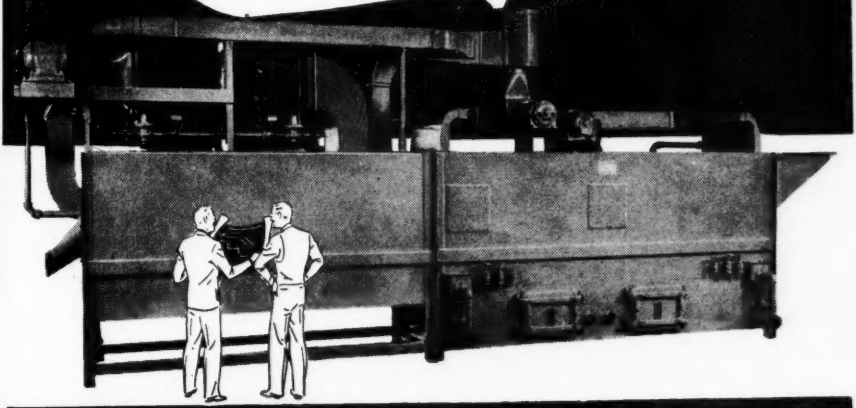

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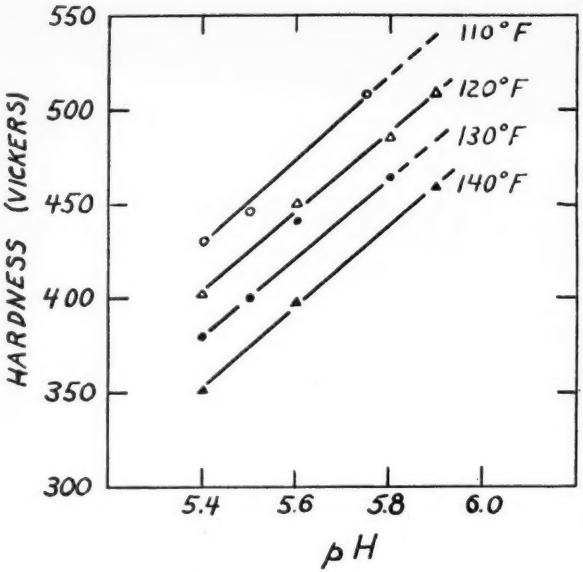

Fig. 1 — Hardness of nickel deposits from modified bath. Cathode current density: 50 amp./sq. ft. (5.4 amp./dm.²).

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to maintain a constant pH.

Effects of Increase in Chloride Concentration. A nickel chloride plating solution offers many advantages over the usual sulfate electrolyte in the production of heavy nickel deposits of moderate hardness.[8] The first attempt to avoid the difficulties encountered in hard nickel plating was therefore a trial of a bath similar to No. 1 (Table I) but containing no sulfate irons. Burning of edges and corners was encountered in plating at 50 amp./sq. ft. (5.4 amp./dm.²) but this defect was readily overcome by doubling the nickel content of the electrolyte to give a composition called "Bath No. 2" in Table I.

The hardness of typical deposits from this chloride bath is shown in Table III which gives evidence of a systematic increase in hard-

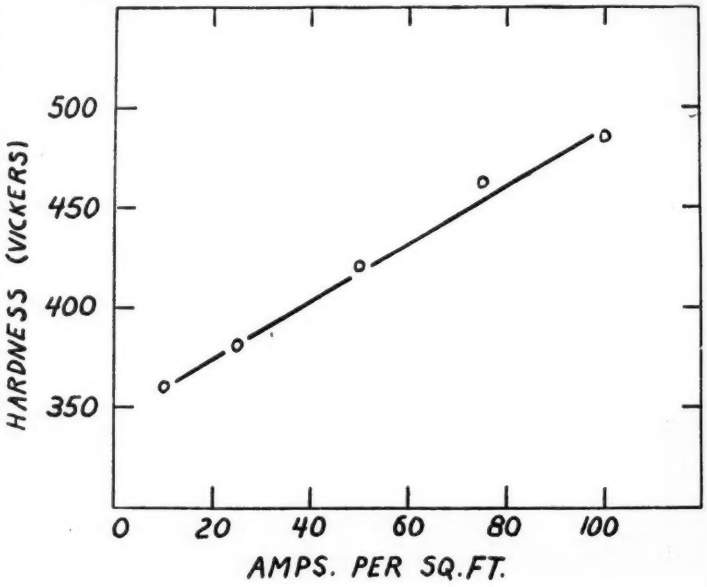

Fig. 2 — Effect of current density upon hardness. Modified bath. Temperature: 130° F. (54° C.). pH 5.7.

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ness of deposit with increase in pH or decrease in temperature. Reproducibility of hardness readings on duplicate deposits made under the same plating conditions was much superior to that crease in hardness. This was so great that deposits of over 440 Vickers hardness cracked spontaneously and even the softer coatings cracked whenever the adherence to the basis

TABLE IV

Hardness of Layers of Nickel from Laminated Deposits

Electrolyte: Original bath (Bath No. 1). Temperature: 127° F. (53° C.). Cathode current density: 50 amp./sq. ft. (5.4 amp./dm.^{2}). pH: 5.6 to 5.7 (Electrometric). Deposits removed from a flat cathode mechanically.

	Experiment		
	1	2	3
First Layer			
Thickness: mm.	0.15	0.46	0.20
Thickness: in.	0.06	0.18	0.08
Hardness of inner surface (Vickers)	510	568	514
Hardness of outer surface	470	360	503
Second Layer			
Thickness: mm.	0.51	0.46	0.28
Thickness: in.	0.20	0.18	0.11
Hardness of inner surface	520	473	566
Hardness of outer surface	350	396	446
Third Layer			
Thickness: mm.	.....	.....	0.18
Thickness: in.	.....	.....	0.07
Hardness of inner surface	.....	.....	409
Hardness of outer surface	.....	.....	380

obtained with the original bath No. 1. Buffer action was excellent, apparently due to the presence of a nickel ammino-chloride complex. Anode and cathode efficiencies were very high. There was no pitting of the deposits, hence no additions of hydrogen peroxide were required. There was practically no change in hardness with increase in deposit thickness and even the heaviest deposits were free from the laminations encountered in nickel from Bath No. 1.

There was one important disadvantage of the chloride electrolyte, namely, that the deposits from it contained a very high internal stress which appeared to increase with in- metal was not good. No way was found to overcome this defect of the chloride bath without sacrificing the desired high hardness of the deposits.

The next step in seeking an improved electrolyte was to revert to the original bath No. 1, but to alter it by replacing about 25 per cent of the $NiSO_4$ with $NiCl_2$ to give Bath No. 3. This electrolyte possessed but little better buffer action than the original one so that boric acid addition seemed to be the next logical step. Preliminary experiments with Bath No. 4 (Table I) indicated that here was a solution very much superior to the original bath. A slight tendency toward burnt edges at 50

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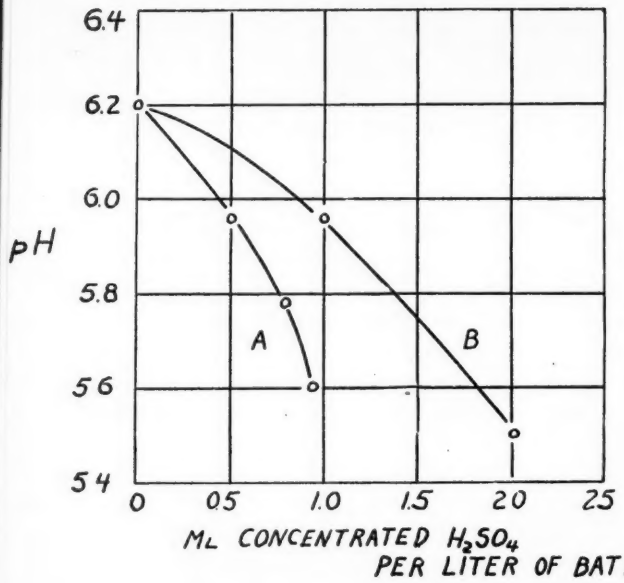

Fig. 3—Titration curves.
A. Original bath.
B. Modified bath.

amp./sq. ft. (5.4 amp./dm.²) led to increase in nickel content. The formal composition of No. 4 having by this time become rather complex (6 ingredients), an equivalent bath, No. 5, was prepared which differed only in being free from potassium. This was named the "Modified Bath" as shown in Table I and it has now been adopted for all hard nickel plating in this laboratory. The effects of various plating conditions upon the hardness of deposits from this bath are shown in Fig. 1 and 2 which provide sufficient information to enable an operator to deposit nickel of a desired hardness at will. The data for the curves shown were obtained by plating on stationary rod cathodes of 1.3 cm. diameter.

Comparison of Original and Modified Baths. The higher chloride content of the "modified bath" permits the use of greater anode current densities at high anode efficiency as compared with the original bath. The buffer capacity of the modified electrolyte is also greater, as indicated by the tritration curves of Fig. 3, and this partly accounts for the fact that the pH of the modified bath rises much less rapidly during use than does the pH of the original solution. This advantage is particularly valuable in plating heavy deposits which require relatively long periods of deposition during which frequent attention to pH would be expensive. The higher chloride content of the modified bath probably also

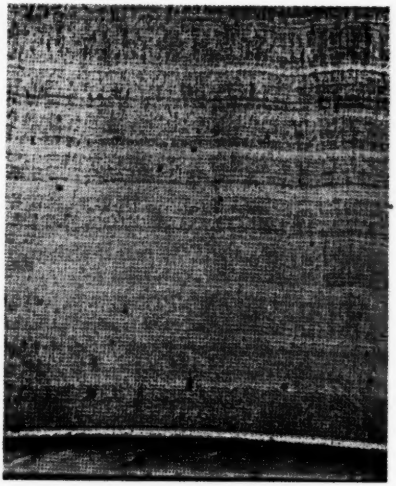

Fig. 4—Structure of deposit from original hard bath No. 1 (Table I) showing rhythmic banding. Section parallel to direction of growth of deposit. Magnification x 100

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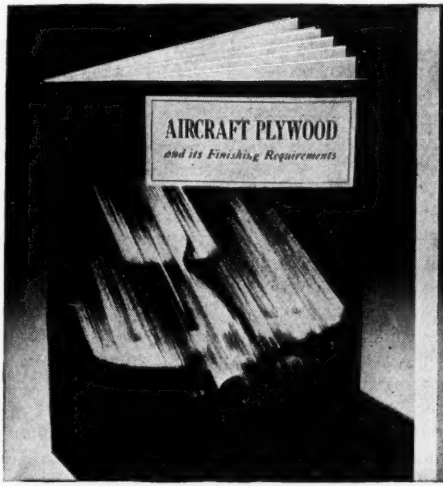

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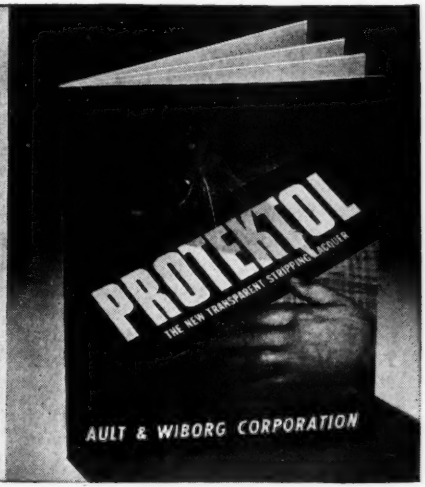

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TABLE V

Variation of Hardness with Thickness

Deposits stripped from nickel-chromium alloy flat sheet cathode. Average cathode current density: 50 amp./sq. ft. (5.4 amp./dm.^{2}).

Electrolyte	Temperature		pH	Thickness		Hardness (Vickers)		
						Surface		Difference
						Inner	Outer	
Original	120° F.	49° C.	5.6	0.019 in.	0.48 mm.	525	495	30
Bath			5.7	0.009	0.23	566	446	120
(No. 1)	130	54	5.6	0.007	0.18	500	330	170
			5.6	0.016	0.40	512	350	162
			5.6	0.021	0.53	519	423	96
	140	60	5.4	0.021	0.53	483	380	97
Modified	120	49	5.7	0.026	0.65	486	466	20
Bath	125	52	5.55	0.019	0.48	434	422	12
(No. 5)	130	54	5.6	0.017	0.43	460	430	30
			5.6	0.020	0.50	432	414	18
			5.6	0.030	0.75	445	426	19
	130	54	5.6	0.008	0.20		431*	
				0.020	0.50		441*	
				0.038	0.95		426*	

* These deposits were made upon 1.0 in. (2.5 cum.) rod and were not stripped.

causes higher cathode efficiency and throwing power, although measurements of these properties have not yet been made. The better control of the hardness of the deposit from the modified bath is evident if the results in Table II are compared with those in Fig. 1.

Rhythmic Banding. The metallographic structure of hard nickel deposits indicates that the grain size is extremely fine, probably sub-microscopic. It is now generally accepted that particles of basic compounds of nickel, perhaps nickel hydrates, of colloidal dimensions are incorporated in the deposit. These compounds promote hardness in two ways: first, by refining the grain size radically; and second, by interfering with slip in a manner similar to the dispersed phase of precipitation-hardened alloys.

When deposits made from the original nickel bath No. 1 are examined metallographically, it is observed that they possess a banded structure which will be called "rhythmic banding" and is illustrated in Fig. 4. This structure revealed upon etching has been noted frequently in nickel deposits, most recently in bright nickel.[1-5] Hothersall and Gardam[4] suggest that the effect is due to differences in chemical composition or differences in stress. Meyer and Phillips[6] discuss rhythmic banding and show that, when it is observed in deposition of copper from a cyanide bath, it is accompanied by a periodic fluctuation of the cathode potential.

It is interesting to speculate upon the possibility that the bands in hard nickel are associated with a periodic variation in the amount of colloidal compounds deposited with the nickel. This suggests a mechanism in which

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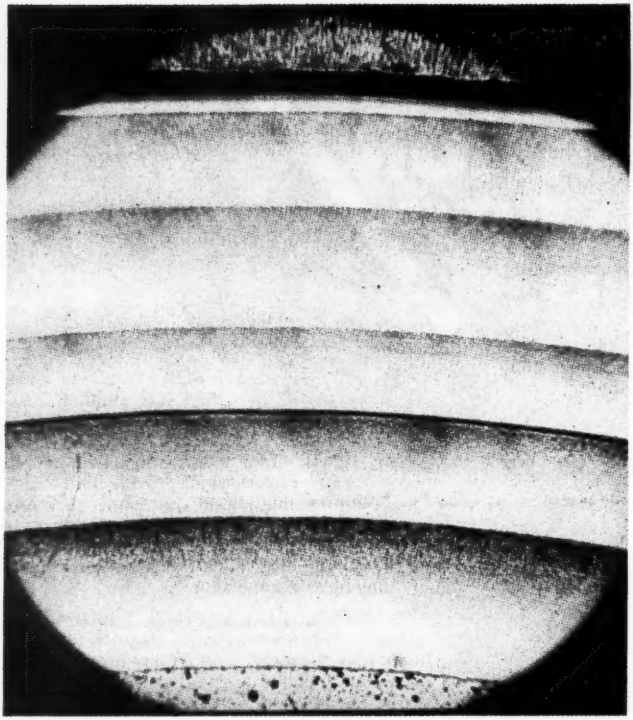

Fig. 5 — Structure of deposit from original bath, showing laminations.
Magnification x 40

diffusion plays an important part, as it does in the formation of Liesegang rings, and perhaps in the banding of impure copper deposits.[7] Since there are no organic colloids in the hard nickel bath, it can be assumed that nickel hydroxide or other basic nickel compound is the colloid involved. As deposition of nickel proceeds, there is a rise in pH of the liquid at the cathode surface due to deposition of a small amount of hydrogen. When the pH of the surface film reaches the precipitation value for nickel hydroxide, the latter is formed in a colloidal state with a positive charge and is codeposited with the metallic nickel. Formation of nickel hydroxide momentarily reduces the pH and the nickel ion concentration, both of which factors reduce the rate of formation of nickel hydroxide, and the cycle is repeated. When the relative rates of diffusion of nickel, hydrogen and other ions, and the rate of migration of the colloidal particles are favorable for setting up a periodic shift of control from one factor to another, there will be a periodic variation in the structure and composition of the deposited metal.

Rhythmic banding was not detected in the deposits from the modified nickel bath (No. 5). This may be due to the higher buffer action of this bath and the presence of the boric acid. It is possible that the striations are so fine as not to be resolvable. It is not believed the rhythmic banding observed in deposits from the original bath is particularly deterimental to the physical properties of the metal, at least not those measured in a direction parallel to the surface.

Laminations. Deposits from the original nickel bath No. 1 which were thicker than about 0.01 in. (0.25 mm.) displayed a microscopic type of striation shown in Fig. 5. This is a serious defect because the adherence between the layers is often so poor that separation occurs as a result of mechanical abuse or machining operations. Similar lamination have been reported

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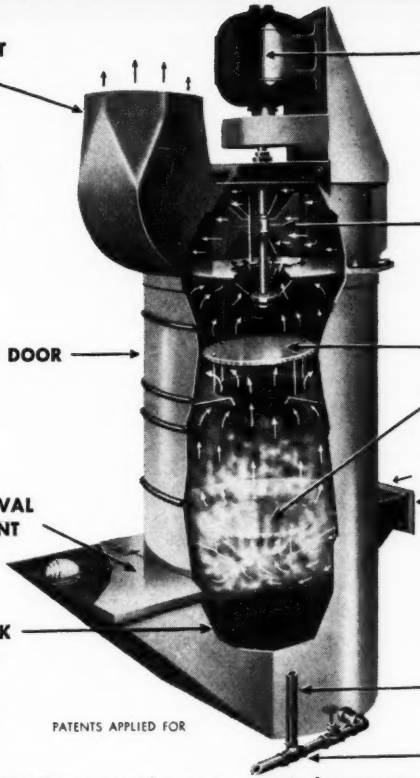

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in heavy deposits of bright nickel and Young[8] observed them in nickel plated from a double salt bath. Deposits from bath No. 5, such as that illustrated in Fig. 6, were free of this particular defect.

is the tendency for crystal growth, a result of the influence of the substrate upon the discharging ions; the other force has a hardening effect, it is due to the tendency for formation of new crystals, which is very strong in de-

TABLE VI

Tensile Strength of Hard Nickel

Thickness of specimens: 0.015 in. (0.38 mm.). Plating conditions: pH 5.6. Temperature: original bath, 49° C. (120° F.); modified bath, 54° C. (130° F.). Current density: 50 amp./sq. ft. (5.4 amp./dm.^{2}).

Electrolyte	Exp. No.	Hardness (Vickers)		Tensile Strength		Elongation % in 2 inches
		Inner Surface	Outer Surface			
Original	(1)	535	325	125,000 lb./sq. in.	8,750 kg./cm.^{2}	2.0
Bath	(1)	535	325	139,000	9,730	2.0
Modified	(2)	434	422	144,000	10,080	9.0
Bath	(2)	434	422	160,000	11,200	7.8
	(3)	416	400	160,000	11,200	4.0
	(3)	416	400	157,000	10,990	5.0
	(4)	414	400	160,000	11,200	5.0

Careful supervision of plating conditions in the original bath established beyond doubt that the laminations appear in the deposits even when there is no interruption of the current nor sudden change in other conditions. A clue to the true cause may be found in other experiments in which the layers of the deposit were separated mechanically and then the hardness of each surface was tested. The results in Table IV show that the hardness of the inner surface of each layer was greater than that of the outer surface, so that there was an abrupt increase in hardness at the moment the lamination formed. It will be noted in Fig. 5 that the softer portion of each layer was much more rapidly attacked by the etching reagent and appeared to be coarser grained than the first formed portion. It is as if there were two forces striving for control of the deposit structure as it grows. One, with a softening effect, position from hard nickel baths.

The inner surface of deposits from the modified bath is harder than the outer, but the difference between the two values is much less than that between two surfaces from the original bath. A number of examples are presented in Table V. Deposits from the modified bath are also less influenced by the hardness of the basis metal. Typical hardness measurements on 0.012 in. (0.3 mm.) thick deposits made from the original bath were 250 Vickers when made upon a copper base, and 456 Vickers when made under the same conditions upon a mild steel base. Similar hardness readings for deposits from the modified bath were 370 Vickers on a copper base and 400 Vickers on a mild steel base.

Treeing. A distinct disadvantage of the original bath No. 1 was a tendency to form large weak "trees" at the edges and corners of the cathodes. Growths as much as 8 to 10 in.

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(20 to 25 cm.) long were observed in building-up deposits of 0.024 in. (0.61 mm.) average thickness. The higher chloride content of the modified bath is considered chiefly responsible for the reduction of this tendency to a degree that is no greater than that of an ordinary Watts bath.

Tensile Strength. Standard sheet tensile specimens conforming to the

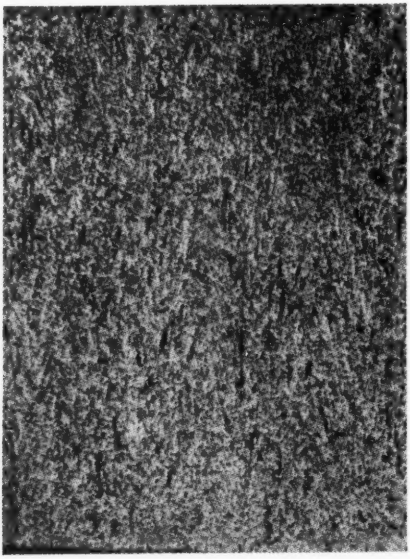

Fig. 6—Structure of deposit from modified bath. Magnification x 100

American Society for Testing Materials Standard Designation E_8-36 were prepared from deposits 0.015 in. (0.38 mm.) thick which had been formed upon a stainless steel starting sheet and removed therefrom. The reduced section of the specimens was 0.500 in. (12.7 mm.) wide and 3 in. (76 mm.) long but the overall length was only 6 in. (152 mm.). Results of the mechanical tests given in Table VI show that the deposits from the modified bath were not only stronger but more ductile than those from the original bath.

Cause of Hardness of Electrodeposits

The fact that electrodeposits can be prepared of much greater hardness than that of wrought forms of the same metals has intrigued many investigators. The time-honored theory that the hardness is due to the presence of hydrogen as a hydride or in solid solution still has many adherents. The principal support for this theory is that the metals which show the most pronounced differences between hardnesses in the cold-worked and electrodeposited forms are also those which show the highest capacities to dissolve atomic hydrogen at room temperatures. Such metals are iron, cobalt, nickel, chromium and palladium. In addition, it is true that the hard deposits of some of these metals have lower softening temperatures than do their commercial wrought forms.

The principal evidence against the hydrogen theory is the following:

(1) About 90 per cent of the hydrogen present in electrodeposits can be removed by warming the metals in a vacuum without appreciable softening.[9]

(2) There is poor correlation between the hydrogen content of nickel deposits and their hardness.[10]

(3) There is poor correlation between the amount of hydrogen deposited during plating and and the hardness of the nickel deposit.[11]

A more plausible theory is one put forward by Macnaughtan, Gardam and Hammond[11] who suggested that hardness is a result of extremely fine grain size and that, in turn, is caused by interference with crystal growth exerted by colloidal nickel hydroxide or other basic compounds which are precipitated in the film of solution on the cathode surface and are occluded with the deposit. Desch[12] suggested the additional requirement that the hardness is not controlled solely by grain size but may also be increased

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TABLE VII

Adhesion of Hard Nickel Deposits

Modified Ollard adhesion test (Reg. 15). Diameter of hole in bushing: 1.020 in. (25.91 mm.). Diameter of hole in test piece: 0.938 in. (23.83 mm.).

Basis Metal	Cleaning Before Plating*	Adhesion Value		Location of Break
Steel (SAE 1340)	Anodic treatment at 200 amp./sq. ft. for 4 min. in 25% H_2SO_4 at room temp. Cold water rinse.	94,500 lb./sq. in.	6,615 kg./cm.^{2}	In steel
		91,700	6,419	In steel
Cast Iron (3.12% C)	Anodic treatment at 100 amp./sq. ft. for 5 min. in 25% H_2SO_4 at room temp. Cold water rinse.	24,400	1,708	In cast iron
		26,900	1,883	In cast iron
Cast Iron (3.12% C)	Anodic treatment as above, followed by deposition of 0.0002 in. copper from a cyanide bath. Cold water rinse. Dip in 10% HCl. Cold water rinse.	7,350	515	In copper layer
		6,850	464	In copper layer

*After preliminary degreasing with solvents and an alkaline electrolytic treatment as cathode.

by the presence of the non-metallic particles in the deposit in a critical state of dispersion. These interfere with slip and cause hardness by a mechanism resembling that ascribed to dispersion-hardened alloys such as duralumin.

In support of the **basic compound theory** can be cited the following evidence:

(1) There is a close correlation between grain size and hardness: the harder the deposit, the finer the grain.[13]

(2) Upon annealing hard deposits at high temperatures, non-metallic inclusions become visible under the microscope in amounts which increase with increase in the initial hardness.[14]

Macnaughtan and Hothersall's work[2] indicated that ammonium salts were most effective in developing sound hard nickel deposits, while boric acid had a softening influence. The present work confirms the effectiveness of ammonium ions but shows that addition of boric acid to the bath already containing ammonium ions alters the hardness but little, yet exerts a beneficial effect upon other properties of the deposit. Explanation of the influence of different cations upon deposit hardness must await clarification of the colloid chemistry of cathode films.[11]

Effect of Heating

Hard nickel deposits have a lower softening temperature than does cold-worked wrought nickel. This is to be expected for three reasons: the electrolytic nickel is of higher purity, it is extremely fine-grained, and it is in a condition of high internal stress.

A sheet of electrodeposited nickel

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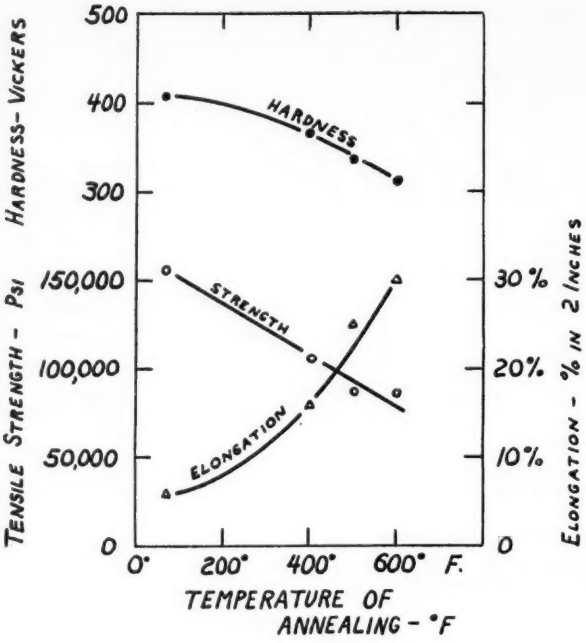

Fig. 7—Effect of heating hard nickel deposits. Time, 18 hours.

0.011 in. (0.28 mm.) thick was prepared in the modified hard bath No. 5 at 130 deg. F. (54 deg. C.), pH 5.6 and 50 amp./sq. ft. (5.4 amp./dm.^{2}). Tensile specimens similar to those of Table VI were prepared and were employed to determine the physical properties of the deposit after heating for 18 hours at one of several different temperatures in a muffle furnace in air. The results are recorded in Fig. 7.

At ordinary temperatures such deposits retain their hardness indefinitely, just as chromium does. Nickel of 470 Vickers hardness made in 1934 still retains this hardness after 7 years.

Adhesion

The adhesion between heavy nickel deposits and various basis metals is dependent chiefly upon the preparation of the basis surface prior to deposition. This is discussed at length in a recent paper by one of the authors[15] which also describes improvements in the Allard technic of quantitative measurement of adhesion. The improved procedure was employed to determine the adherence of hard nickel deposits to steel and cast iron. Deposits 0.09 in. (2.3 mm.) thick were made from the modified bath at pH 5.6, temperature 130 deg. F. (54 deg. C.), and current density 50 amp./sq. ft. (5.4 amp./dm.^{2}). The hardness of these deposits was about 400 Vickers.

The results are recorded in Table VII and show that excellent adhesion can be readily obtained between hard nickel and a steel or cast iron base.

Rate of Deposition

The high cathode efficiency and high Faraday equivalent of nickel deposition offer commercial advantages which can be best appreciated by comparison with chromium deposition, the most widely used industrial plating process. Heavy nickel deposits can be built up much faster than chromium deposits and at lower current densities. These advantages are directly reflected in the cost of producing thick deposits because the costs

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of heavy industrial plating (as contrasted with thin decorative plating) are commonly based upon the length of time during which a tank and generator are tied up for a given job. The following rates of deposition have been observed in plating heavy nickel deposits upon large objects in a tank containing 100 gal. (380 L.) of electrolyte:

Current Density		Rate of Deposition	
Amp./sq. ft.	Amp./dm.^{2}	In. per hr.	Mm. per hr.
25	2.7	0.0012	0.030
50	5.4	0.0025	0.063
100	10.8	0.0051	0.128

The good behavior of the modified bath has been extensively confirmed by operation of the large tank at frequent intervals over a period of several years. This work has included experimental application of heavy deposits to the surface of rolls, the salvaging of worn parts, coating miscellaneous machine parts for resistance to abrasion and, in addition, a small amount of electroforming.

The bath should be made up to the composition given in Table I as bath 5 (Modified Bath) and it should be purified before use as are other nickel baths to remove Fe, Pb, Cu, Zn and organic impurities. The plating conditions required to obtain deposits of a desired hardness can be selected from Fig. 1 and 2. For example, a hardness of about 400 Vickers can be obtained by deposition at 50 amp./sq. ft. (5.4 amp./dm.^{2}) at a temperature of 140 deg. F. (60 deg. C.) and a pH of 5.6. Fig. 3 will be found helpful in estimating the amount of acid required in adjusting the pH during operation of the bath.

This paper was presented at the Eighty-second General Meeting of The Electrochemical Society, Detroit, Mich.

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The size of the enclosure at each plant, however, is less remarkable

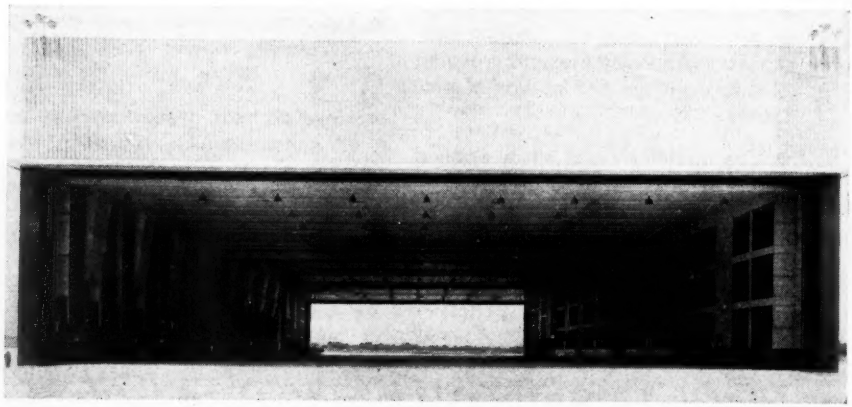

Fig. 1—View through the enclosure, with end doors rolled up to permit entrance of bombers. The air filters through which the air enters the enclosure are at the left, the exhaust units at the right.

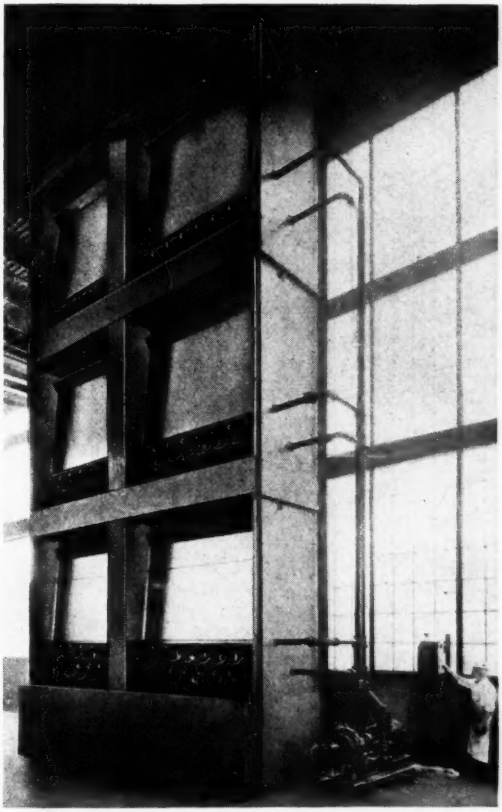

Fig. 2—One of the exhaust units in the fabricating shop, prior to installation.

•

than the ventilating system which was designed to provide a means of exhausting the paint laden air, and replacing it with washed and filtered air. Such a system was required both to protect those handling the spray nozzles from spray and fumes, and to eliminate the fire and explosion hazard.

High Paint-Air-Water Ratio

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For every pound of paint sprayed, there is supplied 5,250 pounds of air and 6,466 pounds of water. This is about five times the paint-air-water ratio of comparable commercial installations. It takes a crew of six men about two hours to paint a plane. Twenty-five gallons of paint are required.

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All equipment for the air supply units is mounted in the roof trusses, taking fresh air from near the roof line. Fans draw the air in through automatic inlet louvres. After being heated by steam coils, washed, and re-heated to a constantly controlled temperature of 80 deg. F., the air is evenly distributed over the entry wall through a system of dampered ductwork.

Admission of the air into the spray enclosure is then made through replaceable glass fiber air filters. These filters consist of mats of fine, interlaced glass fibers coated with a dust-catching adhesive. Their function is to strain out any particles of dust or pollen that may remain in the air stream. They are arranged in 16

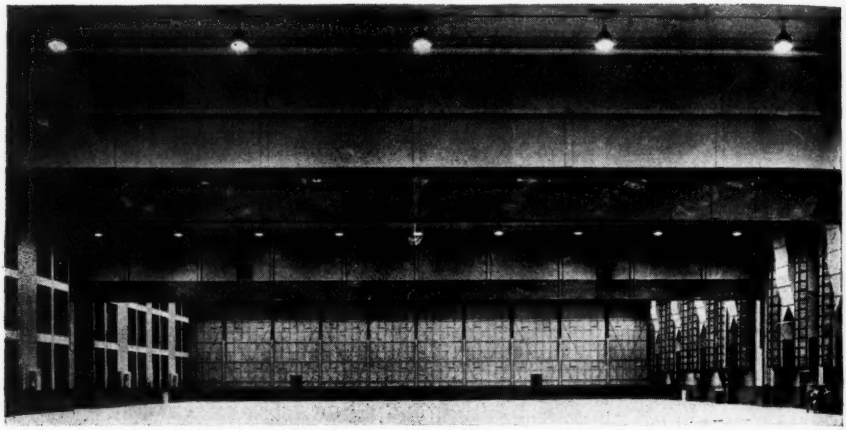


Fig. 3—The filter panels through which the washed, warmed and filtered air enters are at the right. The exhaust units are at the left.

vertical bay panels, each containing 57 filter cells. Each cell provides for 4 filters. Thus 3,648 filters are employed to strain the air entering the enclosure.

The ductwork and filters are so arranged that the clean air enters the enclosure in such a way as to provide an evenly distributed flow from side to side, from floor to ceiling. The overspray from the paint spray guns is carried horizontally by the flow of air from the point where it is produced, across the width of the enclosure, to the nearest exhaust opening at the opposite side. The lighter overspray has no opportunity to settle in traversing the enclosure.

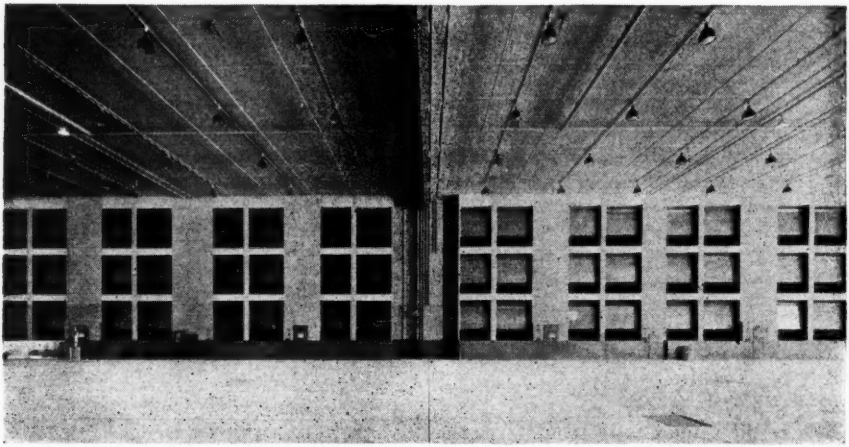
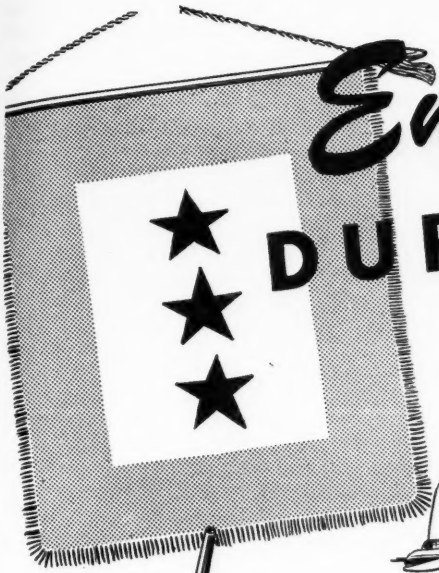


Fig. 4—The exhaust units which clean the paint-laden air and discharge it into the outside atmosphere.



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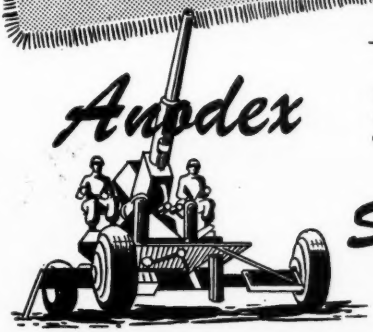

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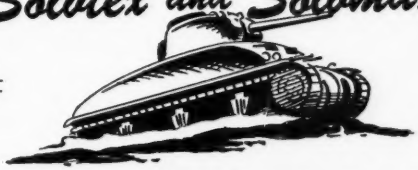

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A suction-draft exhaust fan, located outside of each unit, draws the paint-laden air through a series of conical, high-pressure water sprays, confined in circular orifices. Centrifuge tubes completely separate the water and sludge from the air and deposit them in a sludge tank below. Only clean air passes through the exhaust ducts and fan.

The sludge tank for each unit holds 2,000 gallons of water. The water in these tanks is continuously re-circulated through the units by pumps mounted on the floor in the spaces between them. The only loss of water is from evaporation. Water spray nozzles are in plain sight and readily accessible. There are no concealed eliminators that require removal for cleaning.

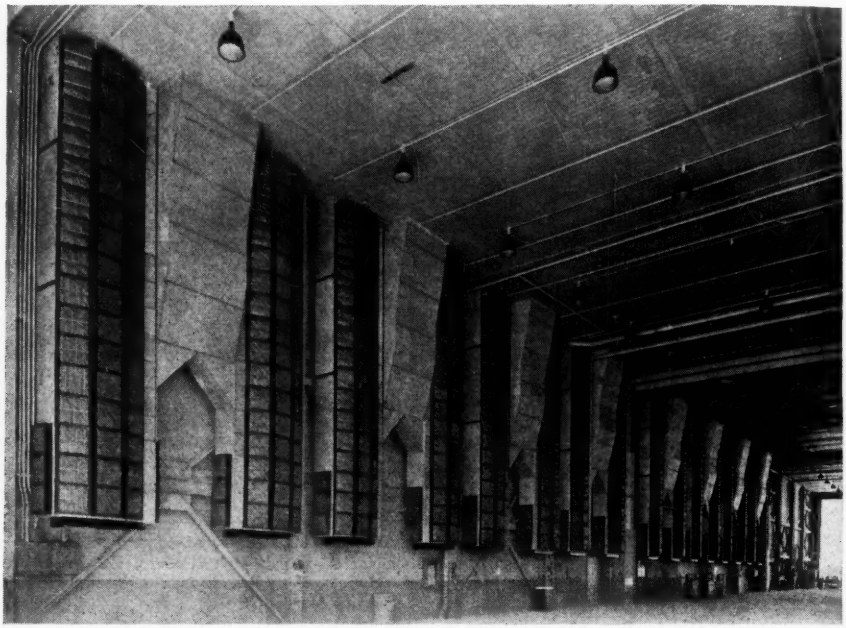

Fig. 5—Glass fiber air filters arranged in 912 cells, each cell containing four filters, line the wall through which the washed, warmed and filtered air enters the enclosure.

Water Sprays and Filters Present Fire Barriers

Should a fire be generated within the enclosure it would be impossible for it to pass through the water sprays and spread through the exhaust system. The glass fiber filters through which the clean air enters at the opposite side of the enclosure do

not support combustion, and would tend to act as a barrier to fire spreading into the supply system. Further, the dust-catching adhesive with which the glass fibers are coated, carries underwriters' approval as a material without smoke or fire hazard.

The entire system is controlled by electric push buttons within reach from the paint floor level. Each of the supply and exhaust units is independently controlled. Any combination of the units can be operated together. Automatically controlled dampers on both the supply and exhaust units close when a unit is shut down and open when it is started up again. When no painting operations are in progress, but the outside temperature requires heat in the structure, about 10 per cent of the capacity of the supply air is drawn in through one unit to maintain a working temperature.

The ventilating systems for the paint spray enclosures at the two bomber plants are practically identical. Both systems were designed, fabricated and installed by the R. C. Mahon Company, Detroit. Owens-Corning Fiberglas Corporation, Toledo, supplied the glass fiber air filters. The plants, including the paint spray structures, are of "Ferroglas" construction, developed jointly by The Austin Company, Truscon Steel Company, and Owens-Corning Fiberglas Corporation. Glass fiber material is used throughout the walls and roofs as thermal insulation.

"The Doors of Victory Are Opening" is the title of an eight-page folder released by the Reznor Mfg. Co., Mercer, Pa., describing and illustrating Reznor Gas Unit Heaters and their use in war production plants, Army, Navy, and Air Corps buildings, and so on. Copy free upon request.

$100.00 War Bonds Now $75.00

Airplane Engine Parts Get an Automatic "Bath"

Operator places baskets or tote boxes of airplane engine parts on conveyor at load end of machine. Material is carried automatically through three units—wash, rinse and blow-off. Operator then removes parts from unload end of machine.

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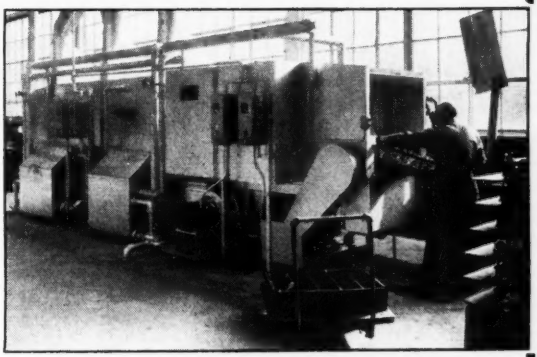
Write for complete details.



This unretouched photograph, taken in a large airplane engine manufacturing plant, shows an INDUSTRIAL Machine in actual operation. Note the absence of water puddles and escaping steam and vapor.

INDUSTRIAL Washing Machine Corp.

291 BURNET ST. **NEW BRUNSWICK, N. J.**

FIRE and how to fight it!

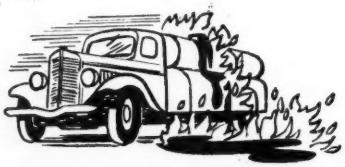
HOW DO YOU KILL FLAMMABLE LIQUID BLAZES?

Q. What are flammable liquid fires?

A. They are fires in oils, gasoline, solvents, paints, lacquers, and the like. Authorities call these Class "B" blazes and recommend extinguishers with a *smothering* or *blanketing* action.

Q. Will every type of extinguisher work on all kinds of flammable liquid fires?

A. No! Water streams, for example, are usually ineffective and extinguishers which employ a liquid stream will generally not handle three-dimensional blazes.



Q. What is a three-dimensional fire?

A. It is a fire which burns at more than one level, as when a container ignites and spills a flowing stream of burning liquid over its sides. Carbon dioxide extinguishers readily handle this type of fire. Work from the bottom up. Kill the fire at the lowest level first.

Q. What is a running fire?

A. It is a flammable liquid blaze which occurs when a flowing stream becomes ignited. You fight this fire by working against the flow of the liquid. If a pipe is leaking, start at the extreme edge of the fire and work back toward the pipe. If a container is spilling its burning contents, work toward the container.

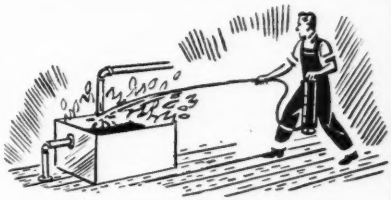
Q. What is a spill fire?

A. This is simply a fire resulting from liquid spilled on the ground or on the floor. Don't try to kill all of this fire at once, if it covers a large area. Start at one point, smother all flames there and continue, part by part, until the entire fire is out.

If you are outdoors, *keep wind at your back.*

Q. How about fires in open vessels?

A. Always "bank" stream from foam or vaporizing liquid extinguishers off inside wall of container. Don't squirt directly on burning surface. With carbon dioxide units, aim discharge at nearest portion then work up on fire with slow sweeping motion.



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Since we have fewer Kidde extinguishers* to sell, we are trying to make your existing fire-fighting units more effective.

If you want reprints of this series of advertisements, just write to

Walter Kidde and Company, Inc., 1131 West Street, Bloomfield, New Jersey.

Kidde

Kidde SNUFFS OUT FIRE

*formerly known as "LUX" extinguishers

Modern Gold Plating — Part 27

By JOSEPH B. KUSHNER, CH. E.
Metal Finishing Consultant
New York City

JUST a short few years ago the electrochemical and metallurgical worlds were introduced to the discovery of electropolishing by Jacquet and contemporary workers who found that practically all metals could be smoothed electrolytically, if properly prepared and treated at high current densities in certain electrolytes. This smoothing, which in a number of cases was sufficient to produce highly lustrous and even brilliant surfaces, was deemed of importance in the field of metallography inasmuch as metallurgical specimens so prepared could be very satisfactorily examined and photographed under the microscope at high magnifications.

Thus, for example, concentrated solutions of orthophosphoric acid were found to brighten copper, mixtures of acetic and perchloric acids did likewise with tin and so on. When a number of people realized that this method of electropolishing small metallurgical specimens might possibly also be applied on a large scale to commercial metal finishing, eliminating to some degree mechanical polishing, a patent rush began. In a period of about three years at least twice that number of patents were issued on the electropolishing of stainless steels, nickel, and so forth, involving a number of acid mixtures, including, sulfuric, acetic, lactic, arsenic, phosphoric and hydrofluoric, just to mention a few of the more important ones.

Yet, at the time electropolishing was discovered for the treatment of metallurgical specimens, electropolishing was being practiced on a commercial scale in the solid gold jewelry field. So, not only was gold the first metal to be commercially electroplated, it was also the first metal to be commercially electropolished. Most electropolishing of gold is on the solid metal and therefore its discussion rightfully does not belong under the subject of gold plating but nevertheless it is an electrolytic process involving gold and therefore we are taking the liberty of including a discussion of it here.

The electropolishing of solid gold is known in the jewelry trade as "stripping" and is mainly employed to produce a bright finish on certain parts of solid gold rings that are inaccessible to a polishing mop or brush. A number of the rings are spread out on a heavy copper rod. This rod becomes the anode, the cathode con-

sists of usually, carbon or graphite though it may be made of copper or steel.

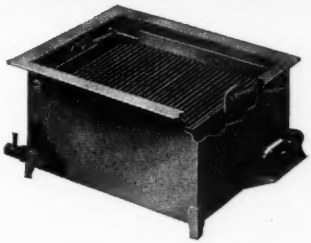
The electrolyte used is quite complex and generally consists of the following standard ingredients: potassium cyanide, rochelle salt, potassium ferrocyanide, copper cyanide and phosphoric acid and ammonia. The voltage applied is usually between 10 and 15 volts and a very high current density, in the neighborhood of 100 to 200 amperes per square foot, is developed. The operator jiggles the copper anode at a very rapid rate, thus producing a considerable amount of agitation. The solution is used hot, practically near the boiling point, and gives off highly noxious and toxic fumes and therefore must be used under a suitable hood. If the solution has been properly prepared the gold rings usually come out sparkling bright after a few moments treatment.

As far as the writer knows, very little research has been done in the field of gold electropolishing and it appears to be a good field for study; the average gold strip is extremely erratic in behavior; one moment a gold strip solution will give a mirror bright finish and the next one, on another piece, a roughening action due to extreme etching.

The fact that rapid motion is necessary to produce a high polish, apparently seems to conflict with a fairly generally accepted theory that electropolishing is a basic diffusion phenomenon in which protective anode film products settle down in the "valleys" or depressions of the metallic object, leaving the "mountains" and high spots vulnerable to the attack of the electrolyte.

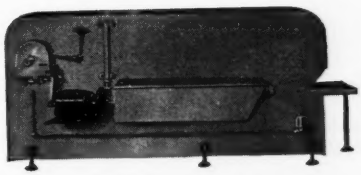
Thus, a gradual leveling for "smoothing" results. The theory seems highly plausible and explains the phenomenon of electropolishing very simply, yet in the case of gold

LOW COST EFFICIENT
Metal Parts CLEANING



STURDY-BILT "SIMPLEX" METAL PARTS CLEANER

This small, compact, automatic and mechanically simple unit combines the two most positive methods of cleaning Metal Parts, Assemblies, Shells, Cartridges, Castings, Stampings, etc. A swishing action positively removes all grease, oil, dirt and metal chips that have been loosened during the "chemical action" of the "soak." Can be installed in different departments or in a series—one unit for cleaning, another for rinsing or rust prevention coating and others for special requirements. Send for "Simplex" bulletin for complete details.



and for Continuous Production
STURDY-BILT "Soaker-Hydro" METAL PARTS CLEANER

Combines long agitated "soak" with hydro washing action for large production. Parts are loaded onto trays, passed through the soaking tank—then are rinsed to remove oil film and clinging chips—then subjected to a power wash. They are removed dry and ready for use or for the next manufacturing operation. Simplicity is the keynote of construction as well as operation. Send for complete details.

Sturdy-Bilt Equipment Corp.
DEPT. P-11 WEST ALLIS, WIS.

electropolishing rapid agitation is required; this agitation undoubtedly disturbs the natural diffusion processes and, therefore, throws a figurative monkey wrench into the theory. This puzzle can only be answered by further research into the problem.

The composition of gold stripping solutions is another point of interest. Most electropolishing solutions consist of one or two at most three components, yet gold requires solutions containing some five different substances. In polishing copper, for example, a concentrated solution of orthophosphoric acid is all that is necessary; and in fact, the writer has achieved fairly good results on this metal with solutions of ordinary ammonium acid phosphate. But with gold, it is necessary to have a cyanide, a ferrocyanide, a phosphate, a tartrate and some ammonia. Incidentally, a good gold strip usually makes an excellent copper electropolishing medium.

Just what the functions are of each of these ingredients is hard to say. We do know that the cyanide and ferrocyanide dissolve the gold. But the functions of the phosphate, tartrate and ammonia are a little doubtful. Since most gold electropolishing is done on carat golds of 18 carat or less, it is possible that the other radicals have some effect in connection with the customary alloying metals of gold, copper and silver.

Also of interest is the fact that the addition of phosphoric acid is highly advantageous in producing a bright finish. As we previously pointed out in another paper, certain weak acids and cyanide combine to form highly complex radicals. Perhaps this has some effect on the anode film that is formed in electropolishing the gold.

Two formulas for electropolishing gold are given here which can be tried by the interested plater but we do not guarantee consistent results with them:

Gold Strip No. 1

Potassium cyanide	9	oz./gal.
Rochelle salt	2	oz./gal.
Potassium ferrocyanide..	2	oz./gal.
Phosphoric acid	2½	oz./gal.
Ammonia	10	cc.

Use the solution hot at about 200 deg. F. The voltage should be between 9 and 10 volts. Use a stainless steel cathode. The bath must very frequently be replenished with fresh cyanide because of its rapid decomposition. Use this solution under a hood with good ventilation and under no circumstances inhale any of the fumes that are given off by the mixture. In operating the solution, use a heavy copper anode bar and move at a very rapid rate with short, jerky motions.

Gold Strip No. 2

Potassium cyanide	12	oz./gal.
Rochelle salt	2½	oz./gal.
Potassium ferrocyanide..	3	oz./gal.
Phosphoric acid (stick form)	2	oz./gal.
Copper cyanide	½	oz./gal.
Ammonia	15	cc.

Use hot at about 190 deg. F. Voltage should be 12 volts or better. Use either stainless steel or carbon cathode. This solution is also highly toxic and should be used under a hood with good ventilation.

Penchlor Acid-Proof Cement. Pennsylvania Salt Manufacturing Co., 1000 Widener Bldg., Philadelphia, Pa., is issuing Booklet No. 6 on Penchlor Acid-Proof Cement.

The new booklet presents recent data together with photographs and charts showing installations and methods of installation. The "how to use" section has been brought up to date, while chemical, physical, and electrical properties are presented in complete detail.

Booklet No. 6 is available to interested companies on request.

$50.00 War Bonds Now $37.50

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Roller Coating Aluminum Alloy Sheets

This unusually interesting article tells how the Douglas Aircraft Company employs the roller coating method to apply a zinc chromate finish to aluminum alloy sheets

By FRED A. HERR

MARKED improvement has been effected in the painting of sheet metal surfaces in one of Douglas Aircraft Company's California plants which has resulted in eliminating the slow and wasteful hand-spray method of finishing aluminum alloy sheet stock for airplane construction.

A mechanical process has been developed which rolls the zinc chromate onto the aluminum alloy sheets in much the same manner as printing a continuous sheet of news print. This darkened aluminized shop coating is the only finish applied prior to final camouflage, when the sheet appears upon exterior surface of the plane, and, in the case of parts used on exterior portions of the aircraft, it is the only finished applied.

The original purpose of the zinc chromate shop coating has been to protect the metal sheet surface from scratching or other damage during fabrication operations. In this case, however, the shop coating fulfills its shop protection function, continuing after assembly as corrosion-proofing on the airplane itself.

The roller coating machine which is used by the Douglas Co. consists of an endless synthetic rubber belt moving through several progressive processes. The aluminum alloy sheets to be painted are removed from the shipping crate and placed upon the moving belt. Oil, dirt and other impurities are first removed from the sheet by spray application of electrically heated caustic solution in a degreasing tank. The aluminum alloy sheet next moves on to a rinse tank where it receives a hot water rinse, also by the spraying method.

From the rinse tank the sheet moves forward along a chain-type studded conveyor which carries the sheet through hot-air driers and toward the revolving steel painting roller units. The rolls are supplied or fed by a continuous feed reservoir operating by gravity flow. Emerging from the rollers paint-side uppermost, the aluminum alloy sheet moves under a second hot air drier toward the end of the conveyor. The sheet then is turned over manually and the unpainted side travels through an identical painting process on a second and duplicate roller coating machine. Speeds are controlled by variable speed drives.

Processing 47-Inch Sheets

Aluminum sheet stock to a maximum thickness of one-quarter inch and maximum width of 48 inches can be handled by the roller coating units. Many sheets go through simple fabrication operations with the shop coating, requiring no retouch after fabrication. This includes such simple forming operations as beading, flanging and certain blanking and hydropress processes.

The primary advantages of a roller coater as compared to conventional hand-spraying, the Douglas Co. has found, are the following:

(a) Routing of a part in and out of paint departments during fabrication is minimized.

(b) The number of paint booths required is reduced.

(c) Evenness of the paint coat is controlled more directly than by hand spray.

(d) Considerable time and paint is saved.

(e) When painted prior to fabrication all parts in an assembly are painted, including exterior portions.

(f) Necessity for spraying on the assembly line with its attendant fire hazard is eliminated.

An additional advantage is the fact that the roller coating process eliminates, or substantially reduces, the

Fig. 1—Interior of painting shop in one of the Douglas Aircraft Co.'s California plants, showing the roller coating machines used in rolling zinc chromate finish on aluminum alloy sheets used in airplane construction. One side of a sheet is painted at one machine, dried in an air-drier, and moved through a second coating machine to have coating applied on other side. Maximum sheet sizes which can be coated by this method are one-quarter inch thick, 48 inches wide.

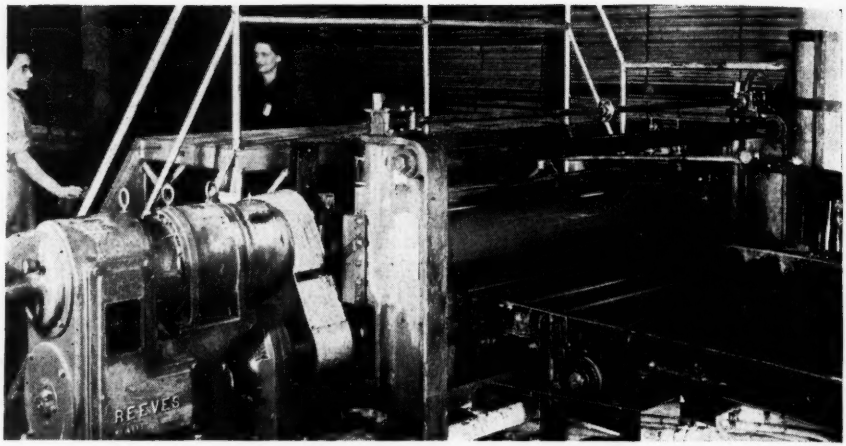

Fig. 2—Close-up view of roller coating machine which applies zinc chromate finish to aluminum alloy sheets

health hazard to which workmen are exposed in metal finishing rooms in which the air is impregnated with harmful ingredients thrown off in the spray method of paint application.

It has been estimated, further, that literally hundreds of man hours per airplane are saved by the roller coating method, which in itself has become an important factor in stepping up plane production during the present war emergency.

Rubber Guide Book. Designed to present maximum information in easily accessible, indexed, condensed form, The B. F. Goodrich Company has just published a 30-page Rubber Guide Book for American War Industries, listing the application and properties of many types of products for industrial and aeronautical purposes using natural, synthetic or reclaimed rubber. The booklet will be mailed upon request, from the company's principal offices in Akron, Ohio.

Well illustrated throughout, the booklet is divided into 11 indexed sections, under the following headings:

Properties of Ameripol (synthetic rubber compounds developed by B. F. Goodrich) hydraulic equipment parts, sponge products, industrial rubber gloves, extruded rubber goods, Anode process of rubber coverings, industrial and aeronautical molded goods, hard rubber parts, rubber cements, lathe cut rubber goods, and properties of reclaimed rubber.

Sub-zero test data, diameter, volume, thickness and hardness tests in oil, and suggested uses for various Ameripol compounds are also given in clear, easy-to-read manner. Cross-sectional drawings add to the clarity of the presentation.

One of the most pertinent chapters in the synthetic rubber section is that devoted to the properties of Ameripol compounds used in handling aromatic, Asiatic or loaded fuels.

Other features include the listing of principal molded goods, and a review of sponge, lathe cut and hard rubber processes using either natural, synthetic or reclaimed rubber.

P & H Trav-Lift Crane Bulletin H-13. An illustrated bulletin showing how P & H Trav-Lift Cranes can be used to speed production in many plants making war materials is now being issued by the Harnischfeger Corp., 4535 W. National Ave., Milwaukee, Wis. Copy of Bulletin H-13 free upon request.

$100.00 War Bonds Now $75.00

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This War Savings Flag which flies today over companies, large and small, all across the land means *business.* It means, first, that 10% of the company's gross pay roll is being invested in War Bonds by the workers voluntarily.

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PRODUCTS FINISHING

Modern Equipment Speeds Casting Cleaning

A CHANGE in cleaning methods for grey ironing castings at Century Foundry, St. Louis, not only lowered cleaning costs, but paid added dividends in providing cleaned work that machined better, took paint and plate finishes more readily, and speeded inspection.

Century Foundry, a subsidiary of Century Electric Co., makes all castings for its parent company—but this work accounts for only one-third of Century Foundry production. The other two-thirds is done for unrelated companies on a regular jobbing basis. Production, accordingly, covers a wide range of casting shapes and sizes.

For many years, twelve tumbling barrels using stars to chip sand and scale from castings had been used for small castings, while large fragile castings were cleaned in a sand blast room. Investigation of modern blast cleaning equipment resulted in selection of a 48 x 42-inch Wheelabrator Tumblast for work previously handled in tumbling barrels. The machine, made by American Foundry Equipment Co., Mishawaka, Ind.,

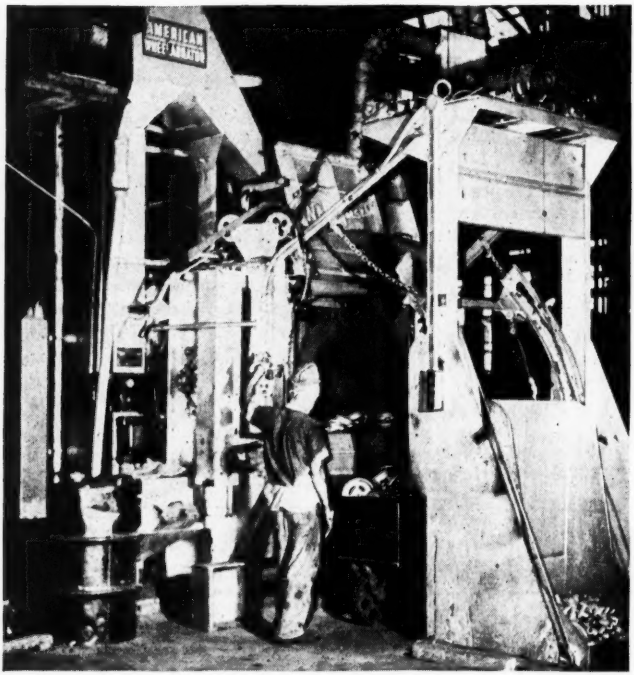

Fig. 1 — Small castings are cleaned at Century Foundry in this 48x42-inch American Wheelabrator Tumblast, with production of 2½ tons an hour and average cleaning time of 10 minutes a load.

has an operating load capacity of 17½ cubic feet, and is designed for production cleaning of metal parts most of which do not weigh more than 75 pounds per piece.

In the Wheelabrator Tumblast, abrasive is thrown onto the work as it tumbles on an apron conveyor. Abrasive is propelled by centrifugal force from a wheel turning 2,250 revolutions per minute, sending the abrasive against the work at 1,150 feet per minute. No compressed air is used by the machine, and any one of several sizes of shot or grit can be used to obtain the surface finish desired on the cleaned work.

At Century Foundry, this machine handles 2½ tons of small castings an hour with an average cleaning time of 10 minutes. While actually doing the work formerly handled by eight tumbling barrels, only four barrels were removed from the cleaning department when the Wheelabrator Tumblast was installed. Under present-day operating schedules, six of the remaining eight rattlers are being used, the other two giving standby protection.

Customer preference for castings that have been Wheelabrated, particularly in work to be painted, plated or machined, has made it advisable to run some work through the machine for a short period, usually five minutes or less, after tumbling with stars. This procedure makes it possible to increase output of Wheelabrated castings above normal capacity of the machine.

Wheelabrated castings, Century Foundry customers found, possessed a finish that would securely hold the final coating, whether paint, enamel, lacquer, zinc, tin or chromium. An additional property of castings cleaned by this method at Century Foundry speeds inspection for defects—eliminating return of castings that might appear perfect but are found defec-

ABRASIVES
and the
WAR EFFORT

The vital part played in the war effort by abrasives, such as grinding wheels and abrasive paper and cloth, is frequently overlooked. Why? Because the industry as a whole meets its promises and delivers the goods without fanfare or fuss.

The General Abrasive Co., manufacturer of electric furnace abrasives, is proud to be an integral part of this important industry. Supplier to the grinding wheel manufacturers and the abrasive coated paper and cloth makers, it also furnishes abrasive grains for polishing and blasting aircraft engines, and hundreds of other vital war products.

The next time you think of operating supplies give a thought to what might happen to your production schedule if the abrasive industry, from the grain maker to the wheel manufacturer, was not backing you up with 100% service and products. The entire production of this important industry is devoted to the war effort and it will continue to supply the demands of the war industries in the months to come with the same quality products and prompt service as in the past.

GENERAL
ABRASIVE COMPANY
Incorporated
NIAGARA FALLS, N. Y., U. S. A.

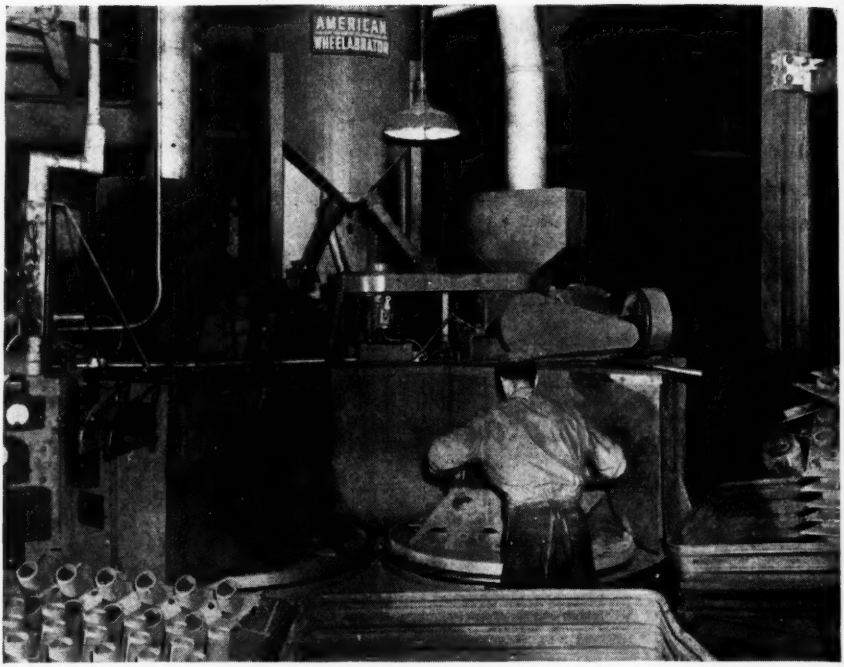

Fig. 2—Fragile castings are cleaned in this American Wheelabrator Tablast at average production of 5 tons an hour.

tive after delivery to the customer. The action of the steel abrasive in striping out every trace of sand, scale, rust or dirt from the smallest fissure or hair-line crack reveals faults in castings before they are shipped.

To extend benefits experienced with airless blast cleaning of small castings to large fragile pieces that could not safely be handled in the Wheelabrator Tumblast, Century Foundry recently installed an American No. 2 Multi-Tablast. This machine has four 36-inch diameter rubber-covered tables upon which the work is placed, and which revolve as the work passes under an abrasive-throwing wheel similar to that employed in the Tumblast. The revolving action of the work tables subjects the entire exposed surface of the work to the full effect of the blast stream.

Castings, many of them relatively flat but having high vertical edges or deep pockets, are passed once under the abrasive blast, and then turned over and passed under the blast againt to clean the opposite side. Production on this machine averages five tons of cleaned castings an hour. It handles about 80 per cent of Century Foundry work formerly cleaned in the sand blast room, the size of some pieces being beyond the capacity of the Wheelabrator Tablast and necessitating continued limited use of the compressed air system. No. 22 steel shot is used in both machines.

$25.00 War Bonds Now $18.75

Hercules Solvents and Thinners. A new 21-page booklet discussing properties and applications of a series of terpene solvents is being issued by the Naval Stores Department of Hercules Powder Company, Delaware Trust Bldg., Wilmington, Delaware.

The booklet emphasizes that while turpentine, which is composed of terpene hydrocarbons, has been used for many years as a solvent and thinner for protective coatings, it is but one of various terpene solvents available today. Thinners and solvents detailed in the booklet have been grouped under five classifications in accordance with their major constituents, as Bicyclic Terpene Hydrocarbons; Monocyclic Terpene Hydrocarbons; Terpene Alcohols; Terpene Ethers; and Terpene Ketones.

Included in the booklet are technical graphs on A.S.T.M. boiling ranges and distillation ranges and on the evaporation rates at 100 deg. C. of Hercules terpene solvents. Structural formulas are pictured, together with tables of typical analyses, citing specific gravity, refractive index, unpolymerized residue, flash point, Kauri-Butanol solvency value, aniline point, Ubbelohde viscosity and color.

In addition to the use of Hercules terpene solvents as single components of paint and varnish formulas, the company says, it is possible by proper selection among them to produce a wide variety of solvents which can be extended further or utilized for special purposes. Blending of terpene solvents by research chemists at the company's experiment station has yielded certain preliminary data on typical blends included in the booklet.

Solvency, volatility, flash point, odor, stability, drying time, flow, sagging, lifting, and skinning are discussed generally. None of the solvent blends tested was found to cause discoloration of white alkyd enamels when air-dried or baked, the booklet reports.

Copy of this booklet will be sent free upon request.

"Republic Lead Coatings" is the title of Bulletin No. 1700 which is now being issued by The United States Stoneware Co., Akron, Ohio. This bulletin contains new information on the subject of homogeneous lead linings. Copy free upon request.

$25.00 War Bonds Now $18.75

How Metso Cleaners prevent waste

LESS DOES MORE

Metso is also saving money in busy metal working plants. Its efficient alkali plus soluble silica, valuable cleaning aid, produces chemically clean parts quickly.

In a shop doing nickel and copper plating, cleaner baths prepared with Metso used only 2.9 lbs. per 1000 sq. ft. as against 4.4 lbs. for the other cleaner.

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ECONOMICAL BASIC SOLUBLE SILICATES

Extension of Electrolytic Tinplating for Helping Alleviate Tin Shortages

"THE desperate necessity of conserving our dwindling stocks of tin due to the shutoff of 80 per cent of the world's tin supply from the Far East has resulted in great dependence being placed on the comparatively new electrolytic tinplating industry. The expansion of this industry is now being rushed to take care of a large portion of the United Nations' tinplate needs."

So said J. H. Hopper, of General Electric's industrial engineering department, in a paper presented before the annual convention of the Association of Iron and Steel Engineers at Pittsburgh, Pennsylvania, recently.

The use of electrolytic tinning as contrasted with the old method of hot dipping saves 60 per cent of the tin, it was pointed out, since it makes possible a thinner and more even application of tin to the base metal.

"Most of the hot-dipped tinplate—considered by some more suitable for certain requirements — is now being used by the armed forces," Mr. Hopper said. "This means that electrolytic tinplate lines now being set up will have to produce a large percentage of the plate needed for tin cans for civilian requirements. Estimates of our 1943 requirements call for 1,400,000 tons of tinplate to be electrolytically coated.

"The vision and courage of some men in the steel industry and others indirectly connected with this industry who pioneered the development of electrolytic tinplate processes many years before Pearl Harbor, has helped greatly in bringing the infant electrolytic tinning industry into maturity almost overnight."

"A year ago," the G-E engineer explained, "there were only two continuous tinplating lines capable of handling strip 30 inches wide at speeds above 300 feet per minute. By the end of the year fourteen new lines will be in operation; by the middle of 1943 there will be 26—most of them designed to handle 36-inch strips at speeds above 600 feet per minute.

In electrolytic tinplating, essentially a continuous process, the modern line takes finished steel strip in coil form from the rolling processes, cleans it, and then deposits a thin coating of tin electrically. Then the strip is recoiled or sheared at the end of the line.

General Electric is now rushing to completion electric equipment of various kinds for many of these tinplating lines. Described at the convention were new large-size heavy-duty copper-oxide rectifier units pioneered by General Electric, thirty-six of which are now under way at G. E.

for three new 60,000-ampere electrolytic tinplating lines.

The rectifiers are to be used in place of large motor-generator sets conventionally used to supply the low-voltage direct-current needed for the process. "The rectifiers are as efficient, take minimum space, and since they have practically no rotating equipment, require minimum maintenance time," said Mr. Hopper.

"The large copper-oxide rectifiers now being built operate on the same principle as smaller units previously available in this country, but are designed for the high currents and heavy duty of steel mills. Standard units are 8 ft. tall, 7 ft. wide, and 6 ft. deep, and include the necessary dry-type rectifiers, transformers, and ventilation equipment."

Another development described in connection with the new tin-plating lines is the application of an amplidyne current regulator to help hold the tinplating current accurately proportional to the strip speed. This is accomplished while the strip is being run through at normal speed as well as when it is being run at reduced speed for welding on a new coil or for stripping the reel.

A variation of the photoelectric-amplidyne side register control, developed by G. E. to keep paper in register, has also been put to work on tinplating lines to assure the winding of tinplate coils with the ends square.

This equipment is based on a "floating reel" principle whereby a photoelectric scanning device mounted on the reel structure is focused on the edge of the strip as the strip passes over a dark-colored roll. Whenever the strip beneath the lens of the scanning head becomes 1/32 of an inch or more off center an electrical impulse is initiated. The reel is then shifted instantaneously to the correct position to keep the coil square.

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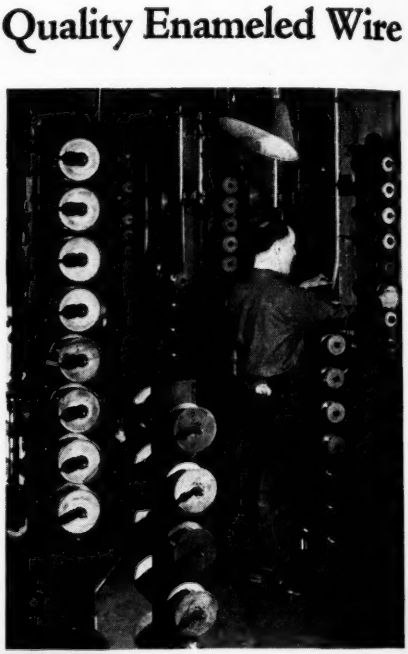
Capacities: 60 to 10,000 G.P.H.

Accurate Control Makes Quality Enameled Wire

UNIFORMITY of enamel insulation on copper wire is obtained by having a constant speed of the wire as the coat is applied and baked. The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., maintains a quality product by supplying constant voltage power from a central motor-generator set. The oven on this tower has a range of temperatures suitable to bake insulation on sizes 26 to 32 B & S. The "Quick Jerk Test" and the "Solvent and Varnish Resistance Tests" are used to check the degree of bake.



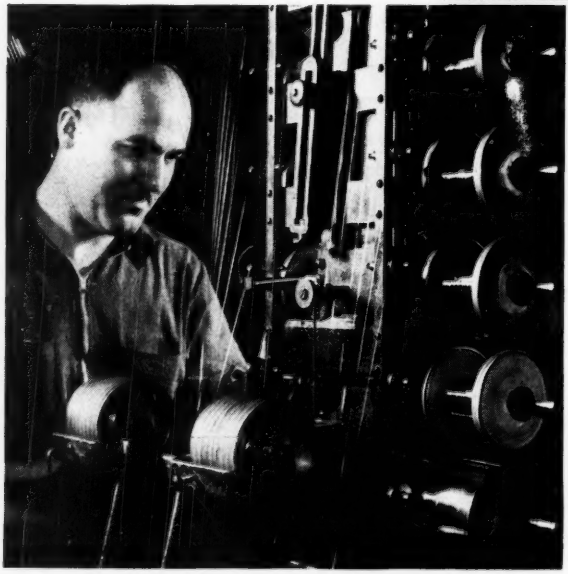


Fig. 1—(Above) Fine threads of copper wire leave the lower tier of spools and run at a constant speed across pulleys and driving capstans to the sheaves. These are partly immersed in the liquid enamel bath directly below the baking oven. A wire receives a coat of insulation each time it leaves the sheave and passes through the baking oven. After the final coat is baked, the wire with its tough but flexible coat of enamel is wound for shipment.

Fig. 3—(Left) Inspection of the coated wire is made near the multiple traverse mechanism which winds the finished product on spools ready for shipment. Suitable tension is maintained on each spool individually by use of a clutch overdrive on each spindle.

Rex Flat Spray Nozzles. Chain Belt Company, 1600 West Bruce St., Milwaukee, Wis., has issued a new illustrated folder describing its REX Spray Nozzles. The illustrations of this ingenious device in the folder show various uses which range all the way from cooling fruit in packing plants and cleaning trolley busses in garages to descaling sheets and plates in steel mills.

The nozzle itself is described as a non-clogging device which throws a flat fan-like, hard-hitting spray with such force that it removes dirt and grit from the most irregular surfaces. The high velocity spray is so concentrated that it produces an extremely thin line of impact which amounts to a sharp cutting action. The device was originally developed for cleaning traveling water screens and because of its unusual effectiveness has since been adapted for many other purposes. The folder is known as Bulletin No. 409 and will be sent on request to anyone interested.

Wheelabrator Operator's Manual. A comprehensive, illustrated manual on the care and operation of Wheelabrator airless abrasive blast cleaning equipment is now being published by the American Foundry Equipment Company, 555 S. Byrkit St., Mishawaka, Ind. Those responsible for Wheelabrator machines will find the book packed with ideas which will help to increase metal cleaning production and decrease operating costs.

The instructions and suggestions contained in the manual, all based upon practical operating experience, will enable the Wheelabrator operator to keep his blast cleaning equipment in the best possible mechanical condition and to obtain maximum performance.

Subjects covered in the booklet include: Care of the Wheelabrator Unit, General Maintenance Hints, Electrical Instructions, Ventilation Requirements, Proper Use of Abrasive, Operation of Wheelabrator Tumblasts, and miscellaneous suggestions.

Although the Wheelabrator Operator's Manual is intended primarily for users of Wheelabrator equipment, much of the information will be of interest to all users of abrasive blast cleaning equipment. Copies may be obtained free upon request.

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Agitation does not produce excessive suds in a Sprex MH solution—hence no "air-binding" or "foaming over."
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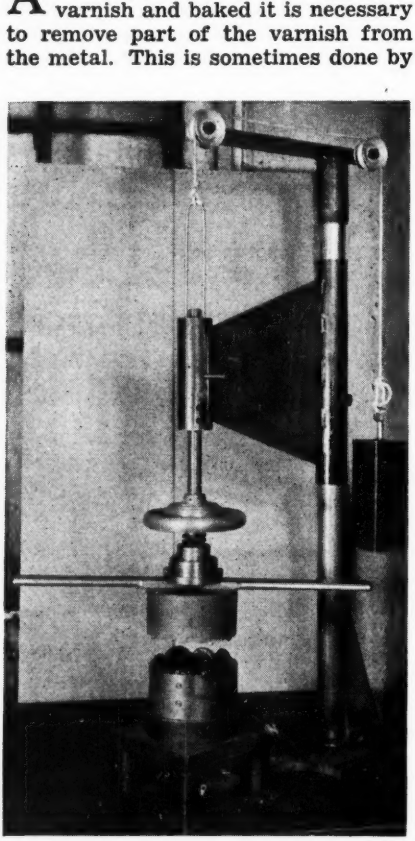
Warehouse stocks in cities from coast to coast

Finishing Facts

How to Remove Varnish from a Bracket Fit

AFTER parts have been dipped in varnish and baked it is necessary to remove part of the varnish from the metal. This is sometimes done by sanding or buffing. However, if the parts are identical and in large numbers; other methods, such as that in use at Westinghouse Electric and Manufacturing Company, Lima, Ohio, are found to be very effective.



Varnish is cleaned off bracket fits thoroughly and at a saving in time by this hollow mill used in the Westinghouse Small Motor Division, Lima, Ohio.

A hollow mill supported from a stand and counter-balanced for ease of operation is used to remove varnish from the bracket fit of small motor frames. The cutter is lowered until a pin in the slide nut engages in the lowest notch in the guide. The cutter is rotated manually and the desired pressure is supplied by turning a handwheel. When the bracket fit has been properly cleaned, the pressure is released; the slide nut is disengaged from the pin, and the cutter is pulled upward by a counter-balancing weight.

A shell cutter is required for each frame size. A side clearance on the teeth is omitted to prevent the diameter of the frame fit from being affected. To keep the depth of the cleaned surface constant four of the twelve teeth have no back clearance. A spring under the handwheel cushions the cutter to permit starting on irregular surfaces, thus compensating for any misalignment.

A Modern "Fool-Proof" Nickel Plating Solution

ALTHOUGH bright nickel plating is almost universally recognized for its many advantages, still a great deal of dull nickel plating is being done. On war work particularly, dull nickel plating is frequently specified.

For those platers who still wish to do dull nickel plating, the following dull nickel solution is recommended:

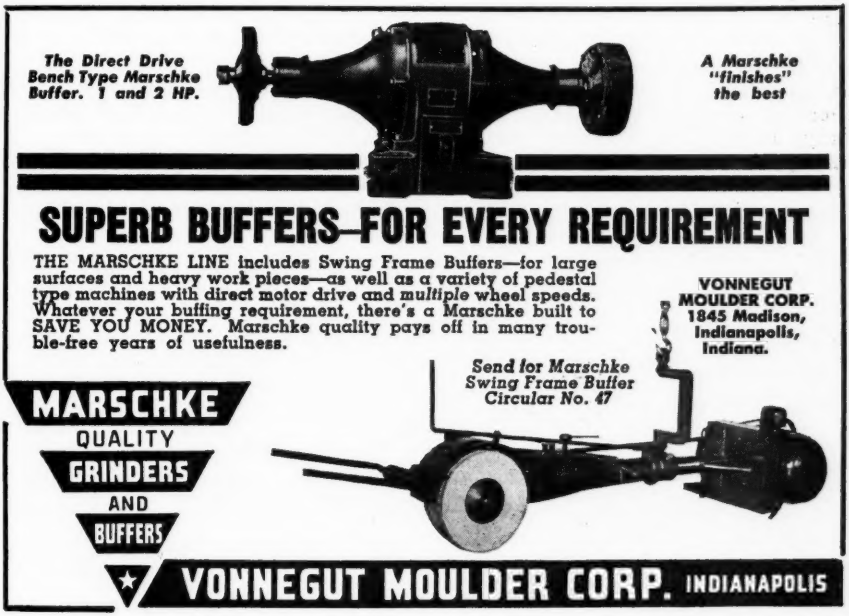
Nickel sulfate (single nickel salts) .....36 oz./gal.
Nickel chloride ..... 6 oz./gal.
Boric acid ..... 6 oz./gal.
Wetting agent .....0.14 oz./gal.

This solution is operated under the following conditions:

pH .....3.0-4.3 colorimetric (usual range 3.6-3.8)
Temperature.....115-125 deg. F.
Surface tension..30-35 dynes/sq. cm.
Current density....20-40 amp./sq. ft.
Anodes.....99 plus % depolarized (if possible)
Cathode rod agitation.....11 ft./min.

For conditions of maximum current density the nickel chloride content may be raised to 16 oz./gal., at which figure 50 amp./sq. ft. may be used. The item "wetting agent" refers to any of that group of products of which Crown Anti-Pit powder, P. & G. Orvus, Metanol, Duponal, Naccanol, and so on, are representatives. Although the writer has used the Anti-Pit powder sold by the Crown Rheostat Company in this solution with great success, it is certain that some of the others would work just as well. These wetting agents lower the interfacial tension between gas bubbles and the solution, and allow the hydrogen and air bubbles to slide harmlessly off the work without causing pitting.

Another modern means of preventing pitting is the employment of activated carbon, activated clay, or a mixture of both to remove the many minute but active impurities in the solutions. The nickel solution may be so purified before any wetting agent is added, or it may be purified periodically, after which the wetting agent must be replaced. The carbon treatment removes wetting agents along with organic impurities.


The Direct Drive Bench Type Marschke Buffer. 1 and 2 HP.
A Marschke "finishes" the best
SUPERB BUFFERS—FOR EVERY REQUIREMENT
THE MARSCHKE LINE includes Swing Frame Buffers—for large surfaces and heavy work pieces—as well as a variety of pedestal type machines with direct motor drive and multiple wheel speeds. Whatever your buffing requirement, there's a Marschke built to SAVE YOU MONEY. Marschke quality pays off in many trouble-free years of usefulness.
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MARSCHKE
QUALITY
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When the above-mentioned nickel solution is used, it is almost a "foolproof" solution. Only the pH must be tested frequently and adjusted. Otherwise it will operate literally for months with little or no attention. The formula or solution ingredients may be varied considerably without impairing the performance of the solution to any great extent. The current density may vary greatly without causing burning or poor deposits. If the plater wishes to do dull nickel plating, this solution is the "last word."

Wheelco Temperature Control

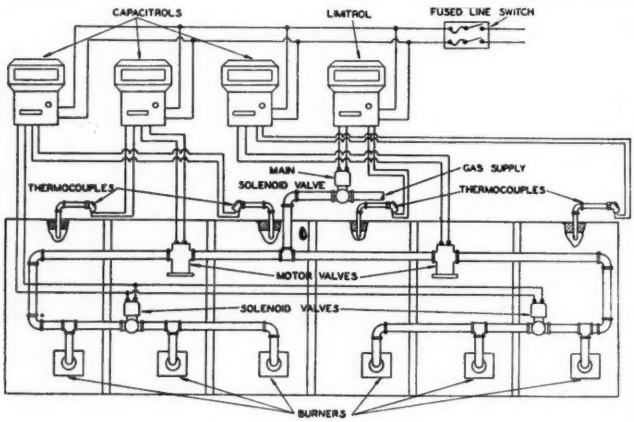
A TEMPERATURE control application designed to maintain even heat throughout a multiple-burner furnace or oven regardless of heat loss at the door or doors; and to give protection against excessive temperature in the event of thermocouple break or upon failure of control apparatus, is illustrated in the accompanying drawing prepared by engineers of Wheelco Instruments Company, Harrison and Peoria Streets, Chicago.

The drawing shows the application adapted to a furnace or oven with doors at both ends, while a modification of this burner and instrument arrangement would provide similar control on equipment with one door.

To replace heat lost at the doors and maintain the entire furnace at even temperature, burners are controlled so that those at the extreme ends burn while those toward the center are out.

One temperature control instrument, shown schematically at the left, actuates two solenoid valves installed ahead of the center burners in the furnace. It is actuated by a thermocouple installed at the center of the furnace. Two thermocouples at respective ends of the furnace actuate two other temperature control instruments, which, in turn, operate two motor valves. These valves are installed in such a manner that one controls all burners on one end of the furnace, and the other valve all burners at the other end. The arrangement permits operation of the furnace with a higher temperature at one end than at the other.

When starting up the furnace or oven, both motor and solenoid valves are held open as the instruments call for heat. The two instruments controlling the motor valves, actuated by thermocouples at the ends of the furnace, are set at the temperatures desired within the furnace, while the



Drawing which shows application of Wheelco Temperature Control to an oven or furnace

remaining temperature control instrument, connected to magnetic valves just ahead of the burners within the furnace, is set slightly lower. When the center of the furnace comes to within a few degrees of the desired temperature, the third instrument closes off fuel to the center burners, leaving the end burners hold the furnace to heat by means of the other two instruments.

When operating the equipment on a continuous car-type principle with a temperature at the start of the process or treatment differing from the temperature at the end, control instruments at the ends of the furnace are set accordingly, while the instrument controlling center burners is set at an in-between point.

In either continuous car or batch-type operation, the temperature control arrangement provides the exact temperature desired at all points within the furnace, offsetting heat lost at the door or doors.

Protection against instrument thermocouple or control apparatus failure is provided by a Limitrol, which, when actuated by a thermocouple mounted at the center of the furnace, shuts off fuel supply to all burners by means of a solenoid valve installed in the main gas supply line. This instrument is set a few degrees higher than the maximum temperature indicated by the highest of the temperature control instruments, and shuts down the equipment if this excessive temperature is reached.

Burgess Model No. 210 Acousti-Booth for all types of industrial plants is the subject of an illustrated and descriptive four-page bulletin released by the Burgess Battery Co., Acoustic Division, 536 W. Huron St., Chicago, Ill. Copy of Bulletin 144 free upon request.

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A positive "MUST" in your plant if you're producing complete units or parts which require:

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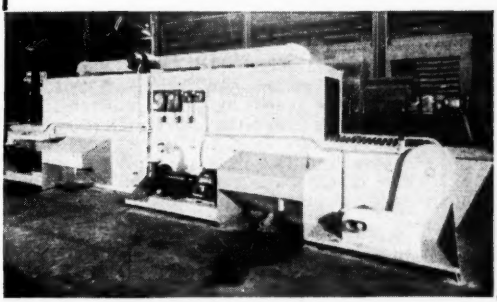
washing . . rinsing . . drying . . rustproofing . . parkerizing . . burnishing . . sawdust-polishing



Conveyor - type washing and rinsing machine for handling large heavy work directly on conveyor or smaller, fragile parts in baskets.

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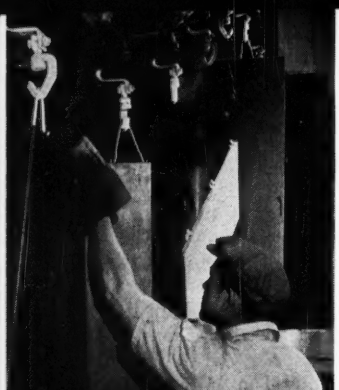


News OF THE INDUSTRY

Now They're All Kidde

Carbon dioxide fire extinguishers and extinguishing systems manufactured by Walter Kidde & Company and previously known as "Lux," "Luxomatic," "Selex," and so on, will henceforth all be labelled "Kidde." Sole exceptions are the "Rich" and "Richaudio" marine detecting systems. Shown here is A. M. Doxsey, Kidde vice-president, placing the new label on a twenty-pound portable model. In line with wartime conservation of scarce materials, the "Kidde" label is being made of steel instead of brass, and is narrower than the previous "lux" label.

New Label for Walter Kidde Products

Newcomb-Davis Changes Name to Newcomb-Detroit

Effective October 1, 1942, the name of Newcomb-David Co., Inc., Detroit, was changed to Newcomb-Detroit Company. This company, established in 1912, manufacturers spray booths, dust collectors, exhaust and ventilating systems, drying ovens and other sheet metal equipment used for industrial purposes.

Continuing as president is Cyrus B. Newcomb, one of the founders of the original company. Clarence A. Dauer is vice-president and Ian B. MacLellan is secretary and treasurer. Other offcers are Avon L. Newcomb, assistant secretary, and William T. Quick, assistant treasurer. No changes have been made in the remainder of the company's personnel.

The Newcomb-Detroit Company will continue to operate in its present plant at 5741 Russell St., Detroit, Mich. This plant, during the past year, has been enlarged to more than double the previous production capacity.

Luminous Coating Materials Exhibit

To aid in the evaluation of luminous materials, the technical committee of the New York Paint Varnish Production Club has set up an extensive exhibit at a laboratory. Officials of Army, Navy Office of Civilian Defense, and other government organizations interested are cordially invited to see the exhibit. Those interested in viewing the exhibit may contact Dr. Joseph J. Mattiello, Hilo Varnish Corporation, 42 Stewart Ave., Brooklyn, New York.

In the first room, sources of black light are shown: a mercury vapor automobile headlight operated on a 6-volt battery; a mercury vapor lamp operated on low a.c. voltage; and a filament type lamp and ordinary light bulbs coated with phosphorescent paint. This room is completely darkened, and various articles coated with luminous materials are seen. They include arm bands, signs, charts, plumbing fixtures, phones, fire extinguishers, sand buckets, buttons, outlines of doors, maps and gadgets.

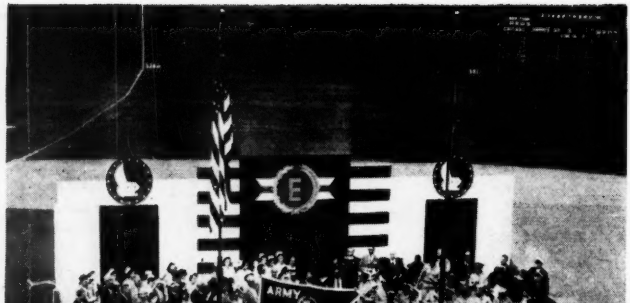
The black light auto lamp is directed on a fluorescent target to show how traffic may be conducted in the dark. A table on which black light is directed from overhead contains many fluorescent articles, fabrics, tape, solutions, plastics, signs, charts, airplane instrument dials, maps, dry pigments and ready-to-use luminous lacquers. A door marked "air raid shelter" leads to a room whose walls and ceiling have been entirely coated with phosphorescent paint.

By way of darkened winding stairs, the visitor is conducted to the next floor above. Fluorescent and phosphorescent directing signs, and steps outlined with phosphorescent paint aid him in this otherwise perilous journey. Other applications of luminous paints and fluorescent dyes are displayed. Continuing to climb the stairs, the visitor arrives at the second floor. On exhibit here is a Mendelsohn black-light lamp that is used in airplanes to illuminate phosphorescent and luminescent instrument dials, charts, and the like.

The concluding item features various degrees of luminosity by using toy automobiles coated with phosphorescent paint. The automobiles represent the lapse of increasing intervals of time after activation. After the observer becomes dark-adapted, the objects are viewed under illumination equivalent to total darkness, a cloudless starlit night, and a bright moonlit night.

Aluminum Industries Receives Army-Navy "E"

Aluminum Industries, Inc., 2438 Beekman St., Cincinnati, Ohio, manufacturer of Permite Aluminum and Magnesium Alloy Castings, Permite Automotive Replacement Parts, steel products, and Permite Industrial Finishes, has been awarded the Army-Navy "E" for high achievement in the production of war materials.



Presentation of Army-Navy "E" Flag to Aluminum Industries, Incorporated. Holding Flag are: (Left) Mr. John Eckerle, President, Aluminum Industries, and (Right) Lt. Colonel W. R. Martin, U. S. A.

The presentation ceremonies at Crosley Field, home of the Cincinnati Reds' baseball team, were held before a large audience comprised of Aluminum Industries' officials, employees, families and friends. The speakers included Governor John W. Bricker of Ohio, in addition to Lt. Col. W. R. Martin of the Army, Commander G. H. Bowman of the Navy, and members of Aluminum Industries' management and workers.

In accepting the "E" Award on behalf of the company, Vice-President Harry J. Hater said, "I pledge the full and continued devotion of our workers to the cause of Victory. They will stand by their guns until the enemies of the American way of life are completely beaten and destroyed."

When the war clouds began to gather, Aluminum Industries Inc. foreseeing a tremendously increased need for the special advantages of aluminum and magnesium alloy castings, inaugurated an extensive new building program. Even before Pearl Harbor, the first units of this new program were in full operation. Now, in four great plants, Aluminum Industries' employees, working in three shifts, are giving their best to the job of turning out products in support of the boys on the battle fronts. Permite Products are being used in building bombers, pursuit ships, and other aircraft, submarines, communication equipment, airfield equipment, radio equipment, ships, tanks, jeeps, blitz wagons, trucks — and many types of production equipment, including machine tools, for war production manufacturers.

International Nickel Wins Third Navy Honor

Announcement of the third war production award to The International Nickel Company plant at Huntington, W. Va., was made by Robert C. Stanley, president, following receipt of official word from Admiral H. A. Wiley, chairman of the Navy Board for Production Awards.

The latest honor gives the plant the right to fly the Army-Navy "E" with two stars. Previously the works had received the Naval Ordnance award, later followed by renewal in the form of the All-Navy "E" award with one star. The plant is among the first 25 throughout the nation, and the first in the Fifth Naval District, to win the two-starred Army-Navy "E" pennant. Each star represents the renewal of production honors for a six months' period. The original award was for a 12-month period.

"On behalf of the Under-Secretary of the Navy, I congratulate every man and woman of the Huntington, W. Va., plant of The International Nickel Company, Inc., on their achievement," Admiral Wiley notified Mr. Stanley.

"This Production Award is not lightly bestowed in the first instance; the requirements for renewal are equally exacting. By being selected for the honor a third time you have demonstrated that

yours is no half-hearted, flash-in-the-pan effort, but rather a solid determination to supply the Army and Navy with the materials they must have to carry the engagement to the enemy. That's the spirit that has made the nation what it is today. It is the spirit that will win this war."

Robitschek to Head U. S. Stoneware Company Research Staff

Dr. Joseph Robitschek has been engaged by The United States Stoneware Company to take charge of its ceramic research program. He will make his headquarters at Tallmadge, Ohio.

Dr. Robitschek has had many years of experience in the production of chemical stoneware and refractory materials in the leading ceramic manufacturing plants in Czechoslovakia, Belgium, France, and Germany. Ceramic engineers will recall his many outstanding contributions to European technical journals.

Phillips at New Location

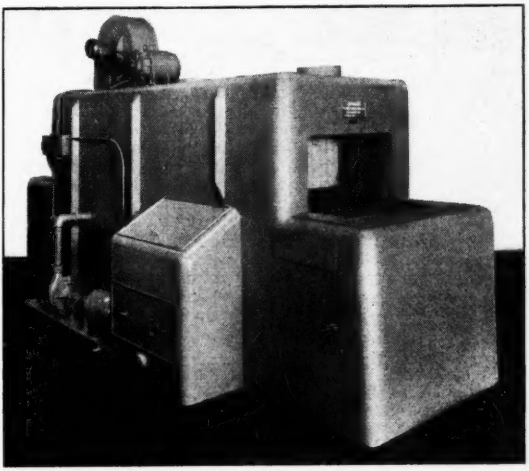
According to a recent announcement, the Phillips Manufacturing Company, formerly at 340 W. Huron St., Chicago, Ill., is now located at its new and enlarged plant at 3475 W. Touhy Ave., Northtown Station, Chicago, Illinois.

Robert W. Renton Joins Lea Staff

Robert W. Renton has become affiliated with The Lea Manufacturing Co., of Waterbury, Conn., to work as Field Consultant in the furtherance of the use of Lea Compound and allied products for burring and polishing in the war industries. The Lea Method of Burring is known widely throughout the metal industries and its use is particularly effective on Ordnance parts, motor parts and aviation accessories.

Mr. Renton has represented The J. B. Ford Sales Co. for several years in the Ohio area and his efforts in his new connection will be in the middle west, chiefly in the state of Ohio.

Our soldiers, sailors, and marines need planes, ships, tanks, ammunition, uniforms, and food. You can help to supply them by buying War Savings Bonds and Stamps.



ILLUSTRATED CATALOG ON REQUEST

HOWARD ENGINEERING & MFG. CO.

1056 HULBERT **CINCINNATI, OHIO**

SPEED UP NOW...

Speed up production now for efficiency and resulting lower cost later when war material production equipment will go back to peace time work. The Conveyor Type Wash and Blow-Off Machine illustrated is easily adapted to many production cleaning problems. Features such as easily maintained motors, pumps, et cetra are readily apparent. Satisfactory results are assumed by Howard's reputation for a "well-built machine, doing the job right."

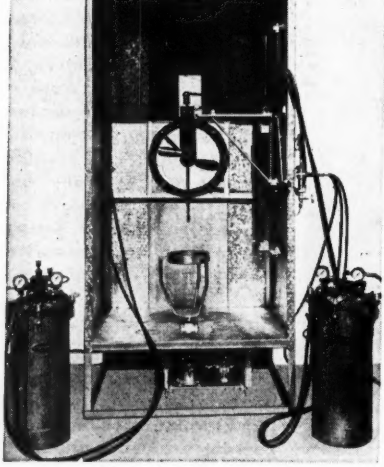
Our engineers, without obligation, will gladly submit details of metal cleaning and finishing machinery to solve your present problem with an eye to the future as well.

New PLANT EQUIPMENT AND Materials

Eclipse Shell Sprayer

A special unit for spray coating 8-in. shells in a vertical position has been built by the Eclipse Air Brush Company, 400 Park Ave., Newark, N. J. The inside coating is done with a semi-automatic spray gun fitted with a long extension nozzle. The outside is sprayed manually by the same operator who handles the inside coating operation.

The shell is rotated by an air motored tripod with a ring at the top to protect the driving band from paint. The rate of production by this method of operation is approximately 25 pieces an hour.



Eclipse Shell Sprayer

Industrial "Tear Down" Washer

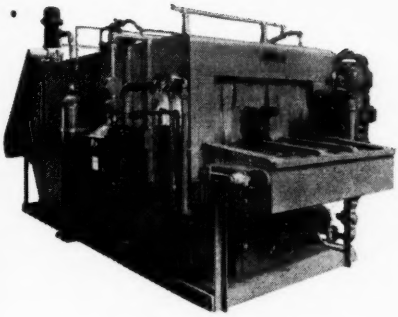
The accompanying illustrations shows an Industrial Washing Machine now being manufactured by Industrial Washing Machine Corporation, 291 Burnet St., New Brunswick, N. J., and used in airplane plants for the washing of engines after "tear down." Every part of the engine passes through the machine and is cleaned and dried.

The operation of the "tear down" machine consists merely of the operator placing the parts on the wire mesh conveyor at the load end of the machine. After this the operation is automatic until it is time to remove the part at the unload end, clean and dry.

After the parts have been placed on the conveyor, they are then carried into the first and then the second wash unit where foreign matter is removed through the medium of high pressure sprays of the proper washing solution. This washing solution is usually Varsol, kerosense, or another suitable solvent. Next, the parts are passed into the rinsing section, where the washing solution is rinsed off and the final filtered sprays assure a thorough job. After the washing and rinsing operations, the parts have excess liquid blown from them in the blowoff unit, and are finally dried in the last section of the machine.

The photograph shows two CO_2 gas tanks. These tanks are part of a fire protection system which forms an integral part of the machine. The system is tied in with the electrical equipment and when actuated manually or automatically shuts down the entire machine and thus prevents spreading of fire hazards.

Also of interest is the fact that this machine is equipped with complete explosion proof electrical layout. All mo-



Industrial Tear Down Washer

tors are operated from the two combination starters, and their non-fusible disconnect switches serve as entrance switches for the entire machine. All the equipment has been mounted on the machine and therefore no additional outside bases are required. Also, pumps, motors, exhausters, are mounted on the machine and require no separate bases.

The vari-speed drive makes the machine flexible and readily adjustable to washing requirements as well as production requirements. The machine shown cleans 1,560 sq. ft. of engine parts every hour.

Duplicating by Electrolytic Process

A new process for multiple production of metal templates has been developed by Lockheed Aircraft Corporation, 1705 Victory Place, Burbank, Calif., in connection with aircraft manufacture. Its application has enabled the company to reproduce duplicate sets of metal templates for a given plane design at a small fraction of the cost involved in individual layout. Actual reproduction on blank sheets from a completed master requires approximately 30 seconds.

The process involves drafting on metal master sheets to produce the original detail layouts, handling of the completed masters through the electrolytic process where the layouts are reproduced in exact duplicate on blank sheets, and final movement of the duplicates to a template department where the layouts are cut out, drilled, and finished for use in the production departments. Size of the individual layouts is limited only by the size of the electrolytic equipment. Reproductions of the master can be made on aluminum or steel sheet or on steel plate. Thickness of the duplicate blank does not affect the process itself, since the only problem then is one of physical handling.

DeVilbiss Type SGF Flow Gun

Designated as the Type SGF, a flow gun designed for caulking, cementing, and other flow operations where plastic materials such as crack fillers, sealing compounds, and heavy paints are used

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THE PACKER MACHINE CO., MERIDEN, CONN., U. S. A.

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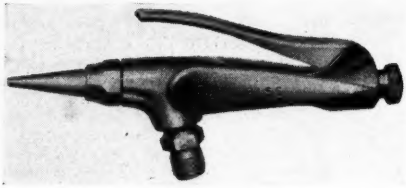


DeVilbiss Type SGF Flow Gun

is announced by The DeVilbiss Co., 300 Phillips Ave., Toledo, Ohio. The gun is said to be particularly useful in doping and cementing fabric parts of aircraft and for a wide variety of similar jobs.

Principal features claimed for the Type SGF flow gun are minimum restriction to flow of material and ease of handling due to the small, lightweight, well balanced design of the unit.

Material is fed to the gun under pressure and is extruded into cracks, grooves, and over seams which are to be sealed. The volume of flow can be controlled either by regulation of the pressure or by a simple knurled nut adjustment of the fluid needle. Nozzles for all materials are available.

HEAT AND ACID
RESISTANT BASKETS
AND CRATES
THOUSANDS
OF HOUR-
PROVEN USE
Every size and shape for every metal finishing and handling operation, whether the load is two ounces or two tons.
Send blue prints and specifications.
Ask for catalog.
ROLOCK INC
1400 KINGS HIGHWAY E., FAIRFIELD CONN.

Fostoria Model MF-240-N Fluorescent Lighting Unit

Announced herewith is the Model MF-240-N Fluorescent Lighting Unit which has been brought out by The Fostoria Pressed Steel Corp., Fostoria, Ohio. Equipped with a patented National Transformer Power Unit No. 999, the unit accommodates two 40-watt Mazda F lamps and turns them on and off in the same manner as incandescent Mazda lamps are turned on and off. The instantaneous starting of the fluorescent lamps is accomplished without starting switches, thus, switch replacement is eliminated.

The standard outside finish on the Model MF-240-N is Hammered Cloud Grey enamel baked by the Near Infra-Red Process—a finish which is said to be permanent and chip-proof. Optional finishes are Hammered tan and green, Wrinkle grey, brown and black, and Gloss grey, green, ivory, and white. The standard reflecting surface is Fostoria Baked Matte-white enamel. Optional reflecting surface is gloss white baked enamel. Both surfaces are easily cleaned.

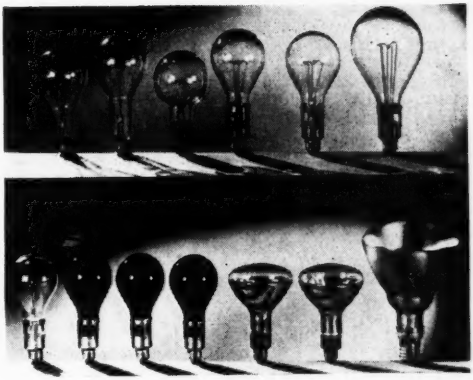
In addition to features already mentioned, other features of the Fostoria Model MF-240-N Fluorescent Lighting Unit include stabilized lamp life, high power factor—60 cycle, a.c., 110-120 volts —maximum lumens per watt, Underwriters' Laboratories approval, elimination of flicker and hum, adjustable bracket for directional lighting, and so on.

Wabash Infra-Red Heat Lamps

A complete line of infra-red heat lamps, designed in keeping with the limitations imposed by the War Production Board, is announced by the Birdseye Division of the Wabash Appliance Corp., 335 Carroll St., Brooklyn, N. Y. The line includes six clear types, three ruby types, and four reflector types. All feature the M-type tungsten filament for uniform heat distribution and have their bases reinforced with asbestos lined mechanical straps to withstand the terrific temperatures of tunnel installations. The reflector types have built-in reflector linings of pure silver sealed inside the bulbs for protection against dimming and tarnishing by fumes or dirt. Average burning life of all is said to be in excess of 6,000 hours.

Wabash engineers report hundreds of thousands of these infra-red lamps already in commercial and industrial use

Wabash Infra-Red Heat Lamps



to speed up baking, drying and dehydrating in war industries. The Birdseye heat lamps produce infra-red and near infra-red rays that are converted into a deeply penetrating kind of heat as soon as they strike an object. Instead of heating from the surface slowly inward, the action is reversed — the infra-red rays penetrate deep down into the surface films of lacquers, paints and enamels to start the baking process from the inside out, instantly and uniformly.

H-VW-M Adhesive for Polishing Wheels

A new type of adhesive has been developed as a substitute for glue in facing polishing wheels by the Hanson-Van Winkle-Munning Co., Matawan, N. J., manufacturer of electroplating equipment and supplies. This material is called H-VW-M Adhesive.

H-VW-M Adhesive is used like glue. Since it is ready to use, it is not necessary to weigh out ingredients or to dissolve and cook beforehand; it may be simply heated and used as soon as warm.

Instructions accompanying H-VW-M Adhesive are as follows: Keep in a cool, dry place. Add H-VW-M Adhesive to

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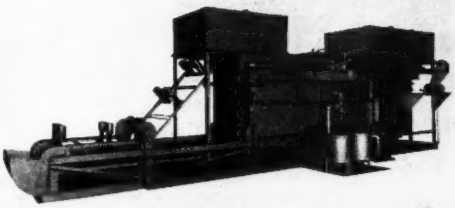
METAL WASHERS
DEGREASERS
PICKLERS
QUENCHERS

BLAKESLEE *engineered-for-you* washers and degreasers are *engineered for speed.* To insure your production, to guarantee clean products, and to meet the top production required by war needs, your problems are considered from every angle. Every factor is considered to give perfection in your washing and degreasing operation.



BLAKESLEE automatic degreaser for cleaning aluminum cases. The parts are automatically degreased in a vapor-spray-vapor operation with final automatic discharge.

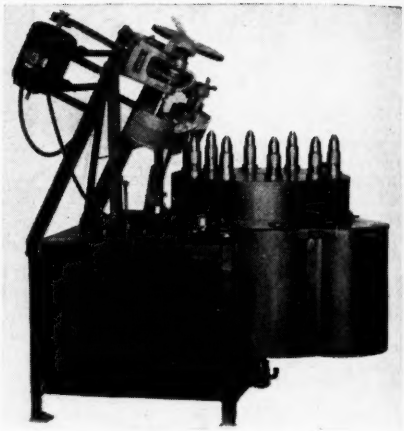
G. S. BLAKESLEE & CO.

NEW YORK CHICAGO TORONTO

the glue pot just as received. This consistency is suitable for coarse abrasives such as No. 60 grain. For finer grain sizes, add water at any time to dilute. Add up to 25 per cent of the weight used when using No. 180 grain. For intermediate grain sizes between No. 60 and No. 180, add water in proportion as needed.

Leiman Shot Tip Polishing Machine

A polishing unit now being marketed by Leiman Bros., EA-134 Christie St., Newark, N. J., is designed to polish one thousand 37 mm. shot tips per hour. This unit is said to be a very important addition to those machines and devices which are being presented with increasing frequency to add to our growing facilities to win the war.



Leiman Shot Tip Polishing Machine

Thirty-seven millimeter shot tips must be prepared for tinning and this machine is so arranged that a number of rotating chucks, mounted on a rotating wheel, hold the parts to be polished. The chucks are loaded at a point where they automatically stop rotating. The rotating wheel indexes intermittently, bringing the work against the running abrasive belt where it dwells for a short period while it becomes polished. The abrasive belt which is driven by a separate motor has a range of three speeds. Two small motors individually drive the chucks and the wheel. The driving mechanism is enclosed in the dust-tight base.

This machine occupies a floor space of about 38 in. by 45 in. and is about 52 in. high. It is available complete, as shown in the accompanying illustration.

Mayer Employee Identification Camera Unit

Designed to photograph up to 250 persons per hour, a compact camera unit for employee identification badge

SPECIFICATIONS!

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Adaptation of formulae to the individual requirements of busy war contractors.

Within specification limits there are many possibilities of improvement in speed, workability, and freedom from rejects.

This PLUS factor is worth considering. We'd like to tell you more about it.

The Varnish Products Co.

Cleveland, Ohio

For a real good polishing job use

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KEYSTONE EMERY MILLS *Write for Sample* 4316 Paul St., Phila., Pa.

Mayer Employee Identification Camera Unit

photographs is now being manufactured by Charles Mayer Studios, Akron, Ohio. The unit includes a camera, two photo flood lights, interchangeable number container, and metal cabinet. All equipment is quickly removable for storage in the cabinet, which requires a floor space of only 15 x 15 inches.

The camera is designed for use with standard 16 exposure film. An arm extending in front of the camera displays interchangeable numbers and automatically holds the subject in absolute focus. According to the manufacturer, the unit can be operated by any office girl since no photographic skill is required.

Polar K Corrosion Proofing

A corrosion proofing oil to be known as Polar K has been added to the Gunk line marketed by the Curran Corporation, 6 Pleasant St., Malden, Mass. This new oil has been developed to remove water, dirt, old oil, and perspiration marks from finished iron and steel surfaces and to leave a film that protects against corrosion.

Applications include protection of metal products in storage such as the water side of steam turbines, pumps, meters, the inside of diesel and gasoline engine cylinders which may have accumulated condensation while standing idle. Polar K is suitable also to flush crankcases. It is soluble in hydrocarbon and lubricating oils, is itself a lubricant and does not have to be removed prior to placing the equipment in service.

Miller-Ivanhoe Fluorescent Lighting Units

Two fluorescent lighting units have been announced by The Miller Co., Meriden, Conn. The first is the Ivanhoe "Masterlite" for general and localized industrial illumination. The Masterlite is a Miller fluorescent unit designed to

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WITH
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IN YOUR METAL CLEANING BATHS
This sulfated fatty alcohol Cleansing Agent is EFFECTIVE
—as a surface tension lowering agent
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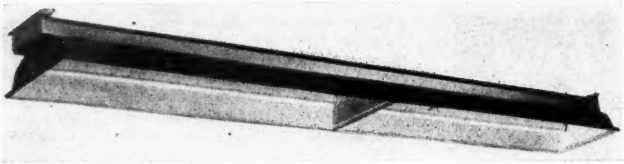
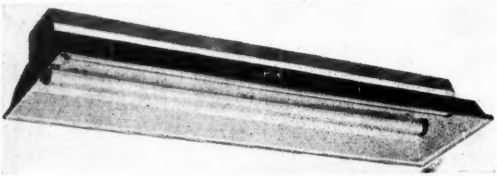


Ivanhoe "Masterlite"

give better general overhead illumination of production areas, and conforms to RLM Standard specifications for a 48-in. two 40-watt unit.

The second unit is the Miller "50 Foot Candler" which is said to be the first 50 foot candle RLM continuous fluorescent lighting unit for general illumination. It is available in either single or double length wiring channels for two or three 40-watt lamps.

Both the Masterlite and the 50 Foot Candler incorporate the Miller construction features of easy installation, wiring simplicity, convenience of maintenance and cleaning.



Miller "50 Foot Candler"

Synthetex Type 50 Insulation

A water clear plating rack insulation to be known as Synthetex Type 50 has been placed on the market by Protective Coatings, Inc., P. O. Box 56-PF, Strathmoor Sta., Detroit, Mich. This material can be used on all metals. It can be applied by dipping, brushing, or spraying and is said to bond tightly when baked at 275 deg. F. for half an hour. The material is also suitable for tank linings and for many types of electrical units.

Synthetex Type 50 plating rack insulation is designed for use in all plating solutions including commercial and hard chrome. The material is available in five gallon lots to all those who have a preference rating of A-1-b or better. Test specimens are available for all those who write to the company on their firm letterhead and state full requirements.

Steel-Grip Finger Guard

The Steel-Grip Finger Guard No. 14717, designed and introduced by Industrial Gloves Company, 722 Garfield Blvd., Danville, Ill., some time ago, has now been improved for certain types of punch

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"INDIAN BRAND" POLISHING ABRASIVE

For nearly forty years we have been producers and refiners of abrasive grains, serving the industry with a strictly quality product for all particular abrasive applications. Accurately Graded — Thoroughly Cleaned — Greater Capillarity — Longer Wear.

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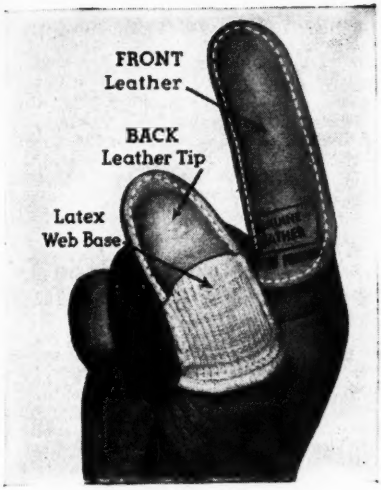

Steel-Grip Finger Guard

press work, sanding, burring, grinding, buffing, assembly, and so forth.

The new feature in this new design, as shown in the illustration, is the added leather section over the back of the finger—at the tip end. This assures the operator of protection on the back of the finger, or thumb, as well as the front.

Adaptability for different sized fingers, comfort, flexibility and close, cool fit, are obtained by the manufacturer's use of special elastic webbing on the back. This genuine leather finger guard is said to afford long wear and sturdy protection, speed up handling of materials, and to eliminate minor but costly finger injuries.

"Pro-Tex" Protective Cream

Designed for use by workers whose hands are exposed to oil, grease, solvents, or paints, a non-medicinal protective cream to be known as "Pro-Tek" is announced by E. I. du Pont de Nemours & Co., Wilmington, Del. The cream is a greaseless substance which is applied to the hands, arms, and under the nails before starting work. The cream forms an invisible film which provides physical protection against grime and various irritating substances, and, at the end of the working period, can be washed off with soap and running water, thus eliminating the need for strong solvents or harsh abrasives.

Sterling Insulating Varnish

The Sterling Varnish Company, 159 Ohio River Blvd., Haysville, Pa., has recently developed a new flame-resistant insulating varnish, designated as R-878, which is recommended for class B high temperature insulation.

This new varnish is mechanically strong and dries all the way through when applied to electrical apparatus. After drying, R-878 will not support

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REMOVE RUST — TARNISH — OXIDATION QUICKLY AND SAFELY WITH *PEN-OX-SOL. $1.70 FOR LIQUID CONCENTRATE TO MAKE A GALLON. MERELY ADD WATER! SAVE MONEY!
GUARANTEED EQUAL TO ANY AT ANY PRICE OR MONEY BACK.
Free delivery to industrial plants only East of Miss. 25c more to all points West.
*PEN-OX-SOL . . . FAST PENETRATING OXIDE SOLVENT is free from Muriatic, Sulfuric, Nitric, Oxalic Acid or Cyanide . . . Non-inflammable . . . Harmless to normal skin . . . For surface or immersion cleaning...Equipment cleaned with PEN-OX-SOL will not contaminate food products. Full instructions.
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Permanent blacking in "ONE BATH"

This modern, proved, low temperature (300° F.) salt bath blacking process is applicable to all types of iron and steel fabrications. It provides low cost, permanent black with effective rust proofing qualities. Because "one bath" does the job, valuable time is saved which in many cases results in a 50 to 90% speed up in production. Application costs run from ½¢ to 1¢ per lb. of metal for all charges including labor.
Depth of penetration and color guaranteed. *WRITE FOR DETAILS!*
Mitchell-Bradford Chemical Co.
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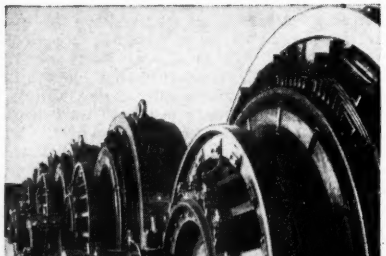


Illustration showing large electrical units, the windings of which have been coated with Sterling Flame-Resistant Insulating Varnish

combustion when the flame is removed, neither will it melt nor resoften under operating temperatures, according to the manufacturer. In addition to good heat resisting qualities, it is said to have all the characteristics of high-grade insulating varnishes.

This new flame-resistant insulating varnish is one of the many contributions of the Sterling Varnish Company to the all-out war effort.

Gunk XP-92

A hand-wiping safety solvent to be substituted for naphtha, gasoline, or kerosene, to be known as Gunk XP-92, has been developed by the Research and Development Laboratory of The Curran Corp., 6 Pleasant St., Malden, Mass. The material is designed primarily for removing cosmoline from rifles. It is also said to be applicable for wide industrial use as a naphtha substitute for grease-cleaning and hand-wiping operations in ordnance or shell plants.

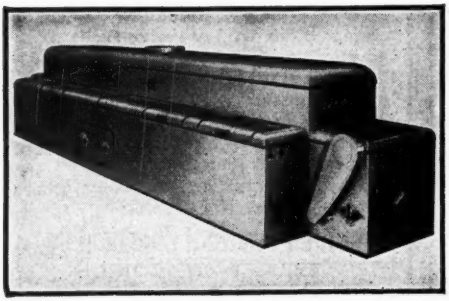
According to the manufacturer, Gunk XP-92 does not de-oil the skin, has no toxic vapors, has no flash or fire point, and leaves an invisible rust preventative film so thin it cannot be detected.

Surface Coating Resin

The Plastics Division of Carbide and Carbon Chemicals Corporation, unit of Union Carbide and Carbon Corporation, 30 E. 42nd St., New York City, announces a new and improved type of vinyl resin for corrosion-resistant maintenance finishes and other coating applications. The new resin, identified as Vinylite Resin VMCH, is characterized by remarkably improved adhesion to a wide variety of surfaces, making possible the formulation of air-dry or low-bake coatings, which possess the same outstanding resistance to corrosive chemicals, to moisture, and to extreme weathering, shown by baked finishes based on the Vinylite vinyl chloride-acetate resins.

The new resin is quite similar to the vinyl chloride-acetate resins in most of its properties and differs only in containing a small amount of an additional ingredient that promotes the development of adhesion. It is completely compatible with the other grades, and may be blended with them in actual use.

For years, coatings and finishes based on the Vinylite vinyl chloride-acetate resins have been supplied by leading lacquer manufacturers to provide lasting durability, and resistance to weathering and corrosive chemicals. Prepared by dissolving the resins in organic solvents, both clear and pigmented coatings may be applied to metals and other surfaces



HYDRO-FLOW
Industrial Washing Machines

Streamlined design. Hidden motors, pumps and pipes are easily assembled. Piping and nozzles located to insure thorough cleansing of all surfaces. Rugged and efficient pressure pump. Corrosion resistant spray nozzles—from mist to open stream. Monorail, Belt or Gravity type conveyors designed to carry any shape or size material. Variable speeds on conveyor drive synchronize production.

International Conveyor & Washer Corp.
Write for circular.
640 E. FORT ST. DETROIT, MICH.

by dipping, roll-coating, knife-coating, brushing or spraying.

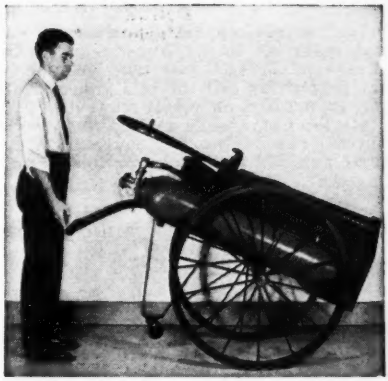
One characteristic which has limited the usefulness of these finishes is their lack of adhesion over impervious surfaces on air-drying. Although they dry solely by evaporation of the solvents, a relatively high-temperature baking operation is necessary to secure maximum adhesion and chemical resistance. When Resin VMCH is incorporated in the formulations, air-drying is sufficient to secure good adhesion and high chemical resistance.

The major field for finishes based on the new resin is believed to be in air-dry coatings for maintenance work, for coating industrial buildings and equipment exposed to very corrosive atmospheres, for coating and lining storage tanks to hold petroleum products, acids, alkalies, or other corrosive materials, and for coatings that must withstand prolonged water soaking or extreme weathering conditions. Test finishes based on Resin VMCH show excellent performance over magnesium and aluminum alloys, particularly on salt water immersion.

Relatively small proportions of Resin VMCH included in baking finishes based on the other vinyl chloride-acetate resins permit excellent adhesion to be obtained at lower baking temperatures. For this reason, Resin VMCH should find application in metal finishes, such as sanitary coatings, metal decorating finishes, and coatings for metal foils, where bakes at 275 to 325 deg. F. are practicable.

"Alfite" 100-Lb. Carbon Dioxide Engine

Known as the "Alfite," a 100-lb. carbon dioxide engine which has been approved by Underwriters' and Associated Factory Mutual Laboratories for use in extinguishing both electrical and oil fires is now being manufactured by the American-LaFrance-Foamite Corp., Elmira, N. Y. A feature of the unit is an Anti-Statik horn which is designed to protect the operator from static charge. In addition, the engine is designed for perfect balance at wheeling height, has a third swivel for easy maneuvering, and a retaining latch which releases horn instantly yet holds it firmly in place when not in use.



"Alfite" 100-Lb. Carbon Dioxide Engine

The Alfite 100-Lb. Carbon Dioxide Engine is recommended for fires in flammable liquids, alcohol storage, electrical machinery, and for other Class "B" and "C" fires. The engine is designed to smother a fire instantly by means of carbon dioxide gas which expands upon discharge to 450 times its stored volume. The gas is noncorrosive, nonpoisonous, and odorless.

Marlox Cleanser

Marley Chemical Company, 1421 E.

ANODES AND SALTS
for every type of plating
THE HARSHAW CHEMICAL CO.
Cleveland, Ohio, and Principal Cities
HARSHAW

Milwaukee Ave., Detroit, Mich., has placed on the market a powdered cleaning material to be known as Marlox Cleanser. This cleaner can be mixed in the proportion of 8 oz. to 1 gal. of water for application on metal surfaces.

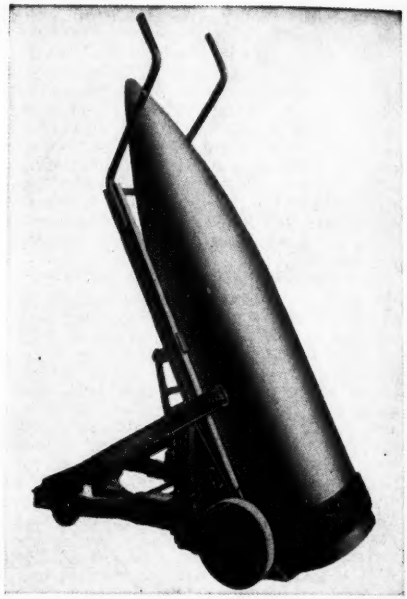
Marley Cleanser is said to remove rust but not rust stains. The material is nontoxic and will not injure workers' hands.

Lewis-Shepard Hydraulic-Release Shell Truck

The Lewis-Shepard Sales Corporation, 245 Walnut Street, Watertown, Mass., offers a Hydraulic-Release Shell Truck, developed for the safe, quick and easy handling of large shells in munition plants.

This particular truck was originally designed to handle shells 72 inches in length with a diameter of 16 inches and weighing 2800 lbs.

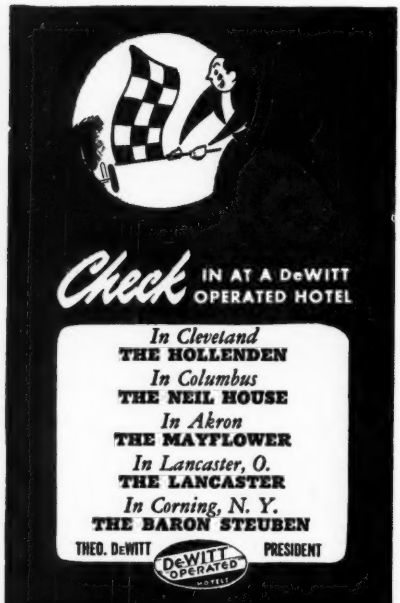
The truck is so designed that the load pivots around a point near its center of gravity. This keeps the load in balance so that one man can easily raise or lower it. It is equipped with a gentle action hydraulic release check which further cushions the movement of the load. It has easy rolling, rubber tired wheels on roller bearings and ball bearings. These advantages allow the operator to maneuver this shell truck in a minimum space.



Lewis-Shepard Hydraulic-Release Shell Truck

To transport the shell, the carriage of the truck is first lowered to a horizontal position by the operator. When ready to unload the truck the single operator again can easily raise the carriage and shell to the vertical position.

This Lewis-Shepard Shell Truck can be made to handle other cylindrical products.



Alkacite Type HM-A1 Tank Lining Material

A tank lining material to be known as Alkacite Type HM-A1 has been placed on the market by Protective Coatings, Inc., P. O. Box 56-PF, Stratmoor Sta., Detroit, Mich. This material is said to resist nitric, hydrofluoric and other powerful acids even at elevated temperatures. It is also impervious to caustics.

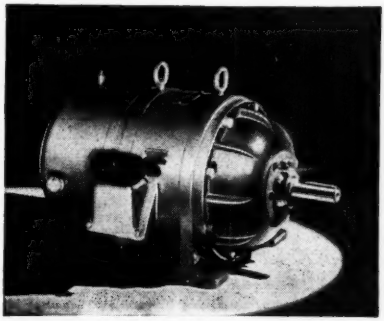
Alkacite Type HM-A1 tank lining material can be applied in a seamless form at the Detroit plant of the firm market-

ing the material. It can be applied to meet various requirements from ¼ in. to ¾ in. thickness. Alkacite Type HM-A1 tank lining material is said to possess unusual resistance to oxidizing reagents and can be used at boiling temperatures.

G-E Motors for Magnesium Dust Locations

A line of polyphase induction motors designed for use in plants handling magnesium, particularly where fine magnesium dust is encountered, has been announced by the General Electric Co., Schenectady, N. Y. Specified as suitable for Class II, Group E locations, the motors are available in sizes from 1 to 20 h.p. with N.E.M.A. frames 203 to 326 inclusive.

The motors are totally enclosed, a non-ventilated construction being employed by motors with smaller ratings and a fan-cooled construction by motors above



G-E Motor for Magnesium Dust Locations

2 h.p. Simple cast-iron end shields, stator frames, and fan housings make possible a dust-tight construction without complicating assembly or disassembly. Additional features of the motors include non-sparking bronze external fans, relatively straight and smooth external ventilating passages (for fan-cooled motors) to facilitate cleaning, permanently sealed-in leads, and rotating labyrinth seals at shaft openings.

Be a Ten-Percenter. Now is the time to contribute ten per cent of your income for War Savings Bonds and Stamps.

Opportunity Section

FOR SALE: 150 feet of ¾" Pangborn Excelsior Sand Blast Hose with connecting fittings. Good as new, purchased recently, used only about 100 hours. STEEL CITY PAINTING COMPANY, Youngstown, Ohio.

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If so, and you are beyond draft age, old established national concern will train you to sell and service chemical products to war industries. If interested send details, experience, age, salary expected, to Box 18, **Products Finishing**, 431 Main St., Cin'ti, O.

THIS Opportunity Section is available for classified advertisements featuring equipment, employment, business opportunities, etc., in the industries devoted to the cleaning, plating, polishing and finishing of metals. For advertising rates and other information address:

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FOR YOUR Catalog LIBRARY

To obtain copies of the catalogs listed here, indicate on the coupon the number of the item in which you are interested and mail as directed.

1. More Light for Work

A new Acme F 100-25, four lamp fluorescent ballast is described in detail, along with other sizes of the Acme Ballast line, in the new Acme Bulletin designated as No. 157 and now being issued by Acme Electric & Mfg. Co., Cuba, New York.

2. Heat Repellent Paints

"Paint Master's Heat-Repellent Low Visibility Paints" is the title of a fully illustrated folder now being issued by Lasting Products Company, 200 S. Franklintown Rd., Baltimore, Maryland.

3. Tygon

A bulletin entitled "At Home in the World of Corrosion" which describes Tygon, a synthetic rubberlike material, is now being issued by The United States Stoneware Company, Akron, Ohio.

4. American Wire Products

The American Wire Form Co., 365 Grant Ave., Jersey City, N. J., is now issuing a catalog covering baskets used in degreasing and other finishing operations.

5. Sturdy-Bilt "Soaker-Hydro" Metal Parts Cleaner

A folder fully describing metal parts cleaning equipment is now being issued by Sturdy-Bilt Equipment Corp., Dept. P-11, West Allis, Wisconsin.

6. Solventol Production Metal Cleaning

Solventol Chemical Products Inc., 15841 Second St., Detroit, Mich., is now issuing a four-page catalog describing Solventol, a new synthetic fluid metal cleaner and conditioner.

7. Handling Baskets to Speed Production

A complete description of baskets for washing, dipping, degreasing, and so on is contained in a four-page catalog now being issued by Union Steel Products Company, 40 Pine St., Albion, Michigan.

8. Rolock Specialized Processing Carriers

In a four-page catalog, Rolock Inc., 1400 Kings Highway E., Fairfield, Conn., presents its line of industrial baskets, crates, trays, and fixtures.

9. Pentrate—the Modern Finish for Steel

One of the most beautifully illustrated catalogs issued by the Heatbath Corporation, P. O. Box 78, Springfield, Mass., describes the Pentrate Phytanium Blended finish for steel products of all kinds.

10. Hard Chromium Plating

A 16-page data bulletin summarizing the applications of industrial chromium plating is now being issued by United Chromium, Inc., 51 East 42nd St., New York City.